U.S. PATENT DOCUMENTS

2,718,539 9/1955 Bradshaw 429/191

Mellors

[45] Reissued Aug. 30, 1983

[54]	SOLID ST	ATE ELECTROLYTES	3,657,016 4/1972 Lilly et al		
[75]	Inventor:	Geoffrey W. Mellors, North Royalton, Ohio	3,973,990 8/1976 Borger et al		
[73]	Assignee:	Union Carbide Corporation, Danbury, Conn.	842829 of 0000 Belgium . 2330127 5/1977 France .		
[21]	Appl. No.:	392,714	OTHER PUBLICATIONS		
[22]	Filed: Jun. 28, 1982		Schoonman, A Solid State Galvanic Cell with		
	Relat	ed U.S. Patent Documents	Fluoride-Conducting Electrolytes, J. Electro. Chem. Science and Techno., Dec. 1976, p. 1772.		
Reis [64]	Reissue of: [64] Patent No.: 4,186,248 Issued: Jan. 29, 1980		Primary Examiner—Donald L. Walton Attorney, Agent, or Firm—Cornelius F. O'Brien		
	Appl. No.		[57] ABSTRACT		
	Filed:	Dec. 27, 1978	A solid state electrolyte comprising an ionically con-		
[51] [52]	[2] U.S. Cl. 429/191 [8] Field of Search 429/191		ducting product of a fused ternary mixture of lead fluoride, an alkali salt of sodium, potassium, rubidium or		
[58] [56]			cesium in a range of 0.1 to 15.0 mole percent and a fluoride, nitrate or sulfate of magnesium, calcium, strontium or barium in a range of between 1 and 40 mole		

percent.

5 Claims, No Drawings

tium or barium in a range of between 1 and 40 mole

SOLID STATE ELECTROLYTES

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specifica-5 tion; matter printed in italics indicates the additions made by reissue.

FIELD OF THE INVENTION

The invention relates to a solid state electrolyte based on a fused ternary mixture containing lead fluoride.

BACKGROUND OF THE INVENTION

Ionic conductivity is usually associated with the flow 15 of ions through an aqueous solution of metallic salts. In the vast majority of practical uses of ionic conductors, i.e., as electrolytes for dry cell batteries, the aqueous solution is immobilized in a paste or gelled matrix to overcome the difficulties associated with handling and 20 packaging a liquid. However, even after immobilization, the system is still subject to possible leakage, has a limited shelf life due to drying out or crystallization of the salts and is suitable for use only within a limited temperature range corresponding to the liquid range of 25 the electrolyte. In addition, the necessity of including a large volume of immobilizing material has hindered the aims of miniaturization.

In attempting to overcome the shortcomings of liquid systems, investigators have surveyed a large number of 30 solid compounds hoping to find compounds which are solid at room temperature and have specific conductances approaching those exhibited by the commonly used liquid system. Most solids have specific conductances at room temperature (20° C.) in the range of 35 10^{-6} to 10^{-15} ohm⁻¹ cm.⁻¹ as compared to aqueous solutions of salts which nominally have a specific conductance of 0.5 to 0.8 ohm $^{-1}$ cm. $^{-1}$.

In addition to the shortcomings of liquid systems, improved microelectronic circuit designs have generally decreased the current requirements for electronic devices. This in turn has enhanced the applicability of solid electrolyte power sources which usually can only deliver currents in the microampere range. These solid 45 barium fluoride and magnesium fluoride. Suitable nielectrolyte systems have the inherent advantages of being free of electrolyte leakage and internal gassing problems due to the absence of a liquid phase and corrosion phenomena. In addition, they also have a much longer shelf life than the conventional liquid power sources.

Solid electrolytes must be essentially electronic insulators so as not to internally short the cell while at the same time they must allow ionic movement in the crystal lattice for the cell to operate. It has been discovered 55 that certain metallic salts which are solids at room temperatures have specific conductances sufficiently high to permit their use in practical battery applications. For example, U.S. Pat. No. 3,723,185 discloses solid state electrolytes of compounds conforming to the general 60 formula AgI-MCN-AgCN or modifications thereof wherein M is potassium, rubidium, cesium of mixtures thereof.

Filed concurrently herewith by applicant and incorporated herein by reference in U.S. application Ser. No. 65 973,554 titled Solid State Electrolyte disclosing a relatively highly conducting solid state electrolyte made from a binary mixture of lead fluoride and a 0.1 to 15.0

mole percent of a selected alkali salt of sodium, potassium, rubidium and cesium.

It is an object of the present invention to provide a novel ionically conductive product that is solid at room temperature and has a high conductance to permit its use as a solid state electrolyte for battery applications.

Another object of the present invention is to provide a novel solid state electrolyte for battery applications that is essentially an electronic insulator so as not to 10 internally short the cell in which it is to be used while at the same time it will allow ionic movement in the crystal lattice.

Another object of the present invention is to provide a novel solid state electrolyte of a fused ternary mixture containing lead fluoride as its major component and having a highly stable ionic conductivity at room temperature thus making it admirably suitable for battery applications.

It is another object of the present invention to provide a highly conducting solid electrolyte based on lead fluoride.

The foregoing and additional objects will become more fully apparent from the following description.

SUMMARY OF THE INVENTION

The invention relates to a solid state electrolyte comprising an ionically conductive product of a fused ternary mixture of lead fluoride (PbF₂), an alkali salt selected from the group of sodium (Na), potassium (K), rubidium (Rb) and cesium (Cs) salts in a range of between about 1.0 and about 15.0 mole percent and a fluoride, nitrate or sulfate of magnesium, calcium, strontium or barium in a range between about 1 and about 40 mole percent. Preferably the range of the former should be between about 1 and about 5 and the range of the latter should be between about 3 and about 10 mole percent based on the electrolyte.

Preferably the ionic conductivity of the solid state electrolyte of this invention should be at least 10^{-5} 40 ohm⁻¹ centimeter⁻¹.

Suitable alkali salts would be potassium fluoride, rubidium fluoride, cesium fluoride, potassium carbonate, potassium sulfate and potassium nitrate. Suitable fluorides would be strontium fluoride, calcium fluoride, trates would be calcium nitrate and strontium nitrate. Suitable sulfates would be calcium sulfate, barium sulfate and strontium sulfate.

While both alpha-PbF₂ and beta-PbF₂ are anionic 50 conductors, the beta-PbF₂ is more conductive but, nonetheless, neither is of the low resistivity that would be highly desirable in a solid electrolyte application. Beta-PbF₂ has a specific resistivity of about 5×10^6 ohmcm, while that of alpha-PbF₂ is about 5×10^7 ohm-cm. If ordinary lead fluoride is heated for a short time above about 350° C. and then cooled, it is entirely converted to the beta form with a characteristic X-ray pattern. However, it has been observed that when this material is compressed to make a pellet for a conductivity measurement, it transforms partially to the alpha form. Although the resistivity of beta-PbF₂ is at levels marginally useful as a solid electrolyte in battery applications, the instability and reversion to the alpha form manifests itself in an increasing resistivity with increase of pressure such as would be employed in the fabrication of a solid electrolyte battery and with increase of temperature and age such as might be experienced during storage of a battery.

It has been discovered that, with the addition of the above-referred to alkali salts in a range between about 0.1 and about 15.0 mole percent and the above-referred to fluorides, nitrates and sulfates in the range of 1 to 40 mole percent to the lead fluoride, the product of the 5 fused ternary mixture produced will have a high ionic conductivity thereby making it suitable for use in battery applications as a solid state electrolyte. It was also unexpectedly found that the addition of the abovereferred to materials to lead fluoride had a very benefi- 10 cial stabilizing effect on the ionic conductivity of the lead fluoride. As used herein, the term "stability" when referring to ionic conductivity shall mean the constancy of ionic conductivity with pressure, temperature and age. As stated above, stability of the ionic conductivity 15 of a solid anionically conductive material is necessary if it is to be used as a solid state electrolyte in battery applications.

EXAMPLE I

Several lead fluoride-containing solid state electrolytes were prepared in the following manner. Lead fluoride along with the specific additions shown in Table I were separately vacuum dried at 140° C. for about an hour. The materials were then intimately 25 mixed, placed in a platinum boat contained in a quartz vessel flushed with argon, and slowly heated up to as high as 850° C. to melt the materials. In the case of easily decomposable or volatile salts, slow heating was used to the minimum temperature necessary to melt the 30 mixture. The melt was thereafter held at this temperature for 15 to 20 minutes to insure a homogeneous mixture. The solidified material was easily removed from the boat on cooling, transferred to a dry box and crushed in an agate mortar. The materials were thereaf- 35 ter formed into pellets measuring 1 sq. cm. cross section by 0.5 to 1.0 cm thick using a Carver Laboratory press operating at 45,000 psi. The resistivity of each pellet was measured and the results obtained are shown in Table I. As evident from the data shown in Table I, the 40 resistivity of lead fluoride which is from 106 to 107 ohmcm decreased with the addition of the materials shown to values as low as 642 ohm-cm.

TABLE I				
Mixture Composition (Molar)	Specific Resistivity (ohm-cm) at Room Temp.			
86PbF ₂ -10CaF ₂ -4KF	1578			
81PbF ₂ -15CaF ₂ -4KF	2750			
76PbF2-20CaF2-4KF	2200	57		
71PbF2-25CaF2-4KF	2500	50		
66PbF2-35CaF2-4KF	1730			
61PbF ₂ -35CaF ₂ -4KF	1800			
79PbF2-6KF-15SrF2	10778			
77PbF2-8KF-15SrF2	1736			
75PbF2-10KF-15SrF2	3000			
86PbF2-10BaF2-4KF	1100	55		
81PbF2-15BaF2-4KF	2800			
76PbF2-20BaF2-4KF	4400			
71PbF2-25BaF2-4KF	14000			
66PbF2-30BaF2-4KF	113000			
61PbF2-35BaF2-4KF	132000			
56PbF2-40BaF2-4KF	483000	60		
86PbF2-10SrF2-4RbF	2660			
86PbF ₂ -10SrF ₂ -4KF	1477			
81PbF ₂ -15SrF ₂ -4KF	2413			
76PbF2-20SrF2-4KF	3544			
71Pbl 2-25SrF2-4KF	9310			
66PbF2-30SrF2-4KF	26000	6:		
61PbF2-35SrF2-4KF	70000			
56PbF2-40SrF2-4KF	269000			
88PbF2-8SrF2-4LiF	380000			
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88PbF₂8SrF₂-4NaF

20000

TABLE I-continued

Composition (Molar)		Mixture	Specific Resistivity	
88PbF ₂ -8SrF ₂ -4CsF 88PbF ₂ 8SrF ₂ -4RbCl 76PbF ₂ -2OCaF ₂ -4RbF 5200 76PbF ₂ -2OBaF ₂ -4RbF 6500 81PbF ₂ -15SrF ₂ -4K ₂ CO ₃ 81PbF ₂ -15SrF ₂ -4K ₂ CO ₃ 7100 81PbF ₂ -15SrF ₂ -4K ₂ CO ₃ 7700 81PbF ₂ -15SrF ₂ -4K ₂ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₃ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₃ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₂ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₂ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₃ CO ₄ 827 76PbF ₂ -2OSrF ₂ -4K ₃ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₂ CO ₃ 76PbF ₂ -2OSrF ₂ -4K ₂ CO ₃ 76PbF ₂ -2CaF ₂ -3KF 94PbF ₂ -3CaF ₂ -3KF 95PbF ₂ -3CaF ₂ -3KF 95PbF ₂ -3CaF ₂ -3KF 95PbF ₂ -3CaF ₂ -3KF 96PbF ₂ -2CaF ₂ -3KF 96PbF ₂ -3CaF ₂ -3KF 96PbF ₂ -3CaF ₂ -3KF 96PbF ₂ -3CaF ₂ -3KF 94PbF ₂ -1MgF ₂ -5KF 1134 94PbF ₂ -1MgF ₂ -5KF 1108 96PbF ₂ -2MgF ₂ -2KF 1108 96PbF ₂ -2MgF ₂ -4KF 1108 96PbF ₂ -2MgF ₂ -4KF 86PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 86PbF ₂ -10MgF ₂ -4KF 86PbF ₂ -10MgF ₂ -4KF 86PbF ₂ -10MgF ₂ -4KF 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1161 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 11700 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 11815 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1165 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1165 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1166 88PbF ₂ -8SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 90PbF ₂ -8SrF ₂ -4KCO ₃ 8PbF ₂ -8SrF ₂		Composition (Molar)	(ohm-cm) at Room Temp.	
88PbF28SrF2-4RbCl 76PbF2-20CaF2-4RbF 76PbF2-20CaF2-4RbF 76PbF2-20BaF2-4RbF 81PbF2-15SrF2-4KBF 81PbF2-15SrF2-4KBF 81PbF2-15SrF2-4K2CO3 81PbF2-15SrF2-4K2CO3 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 96PbF2-2CaF2-2KF 94PbF2-3CaF2-3KF 95PbF2-2CaF2-3KF 95PbF2-2CaF2-3KF 95PbF2-2CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-2KF 1134 94PbF2-1CaF2-5RbCl 96PbF2-2MgF2-2KF 1084 96PbF2-2MgF2-2KF 1094PbF2-1MgF2-5KP 1094PbF2-1MgF2-5KP 1094PbF2-1MgF2-5KP 1094PbF2-1MgF2-5K2CO3 1047 94PbF2-1MgF2-5K2CO3 1047 94PbF2-1OMgF2-4KF 1090 576PbF2-2OMgF2-4KF 1090 576PbF2-2OMgF2-4KF 1090 90PbF2-8SrF2-2K2CO3 1070 90PbF2-8SrF2-4KF 1034 94-5PbF2-0-5CaSO4-5-0KF 1136 94-5PbF2-0-5CaSO4-5-0KF 1136 94-5PbF2-8SrF2-4KCI 1090 88PbF2-8SrF2-4KBF		88PbF ₂ 8SrF ₂ -4RbF	5700	
88PbF28SrF2-4RbCl 76PbF2-20CaF2-4RbF 76PbF2-20CaF2-4RbF 76PbF2-20BaF2-4RbF 81PbF2-15SrF2-4KBF 81PbF2-15SrF2-4KBF 81PbF2-15SrF2-4K2CO3 81PbF2-15SrF2-4K2CO3 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2SO4 96PbF2-2CaF2-2KF 94PbF2-3CaF2-3KF 95PbF2-2CaF2-3KF 95PbF2-2CaF2-3KF 95PbF2-2CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-2KF 1134 94PbF2-1CaF2-5RbCl 96PbF2-2MgF2-2KF 1084 96PbF2-2MgF2-2KF 1094PbF2-1MgF2-5KP 1094PbF2-1MgF2-5KP 1094PbF2-1MgF2-5KP 1094PbF2-1MgF2-5K2CO3 1047 94PbF2-1MgF2-5K2CO3 1047 94PbF2-1OMgF2-4KF 1090 576PbF2-2OMgF2-4KF 1090 576PbF2-2OMgF2-4KF 1090 90PbF2-8SrF2-2K2CO3 1070 90PbF2-8SrF2-4KF 1034 94-5PbF2-0-5CaSO4-5-0KF 1136 94-5PbF2-0-5CaSO4-5-0KF 1136 94-5PbF2-8SrF2-4KCI 1090 88PbF2-8SrF2-4KBF	ı		63000	
76PbF2-20CaF2-4RbF 76PbF2-20BaF2-4RbF 76PbF2-20BaF2-4RbF 81PbF2-15SrF2-4KBr 81PbF2-15SrF2-4KBr 81PbF2-15SrF2-4K2CO3 7100 81PbF2-15SrF2-4K2SO4 8500 76PbF2-20SrF2-4K2SO4 76PbF2-20SrF2-4K2CO3 76PbF2-20SrF2-4K2CO3 76PbF2-20SrF2-4K2SO4 96PbF2-2CaF2-2KF 94PbF2-3CaF2-3KF 94PbF2-3CaF2-3KF 94PbF2-3CaF2-3KF 95PbF2-2CaF2-2KF 94PbF2-1CaF2-5RbCl 94PbF2-2CaF2-4KF 94PbF2-1CaF2-5RbCl 94PbF2-1MgF2-5KF 1134 94PbF2-1MgF2-5KF 1108 96PbF2-2MgF2-4KF 1108 96PbF2-2MgF2-4KF 1108 96PbF2-2MgF2-4KF 1108 96PbF2-1MgF2-5K2CO3 94PbF2-1MgF2-5K2CO3 94PbF2-1MgF2-4K2CO3 1161 88PbF2-8MgF2-4KF 26400 86PbF2-10MgF2-4KF 21900 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 90PbF2-5SrF2-5KF 88PBF2-8SrF2-2K2CO3 1102 86PbF2-10CaF2-2K2CO3 1102 86PbF2-10SrF2-2K2CO3 1103 90PbF2-5SrF2-2K2CO3 1104 90PbF2-5SrF2-2K2CO3 1107 90PbF2-5SrF2-2K2CO3 1107 90PbF2-5SrF2-2K2CO3 1107 90PbF2-5SrF2-2K2CO3 1107 90PbF2-5SrF2-2K2CO3 1107 90PbF2-5SrF2-4KF 1108 96PbF2-10SrF2-2K2CO3 1107 90PbF2-5SrF2-4KF 1108 96PbF2-10SrF2-2K2CO3 1109 90PbF2-5SrF2-4KF 1108 96PbF2-10SrF2-2K2CO3 1109 90PbF2-5SrF2-4KF 1108 96PbF2-10SrF2-4KF 1108 96PbF2-10SrF2-4KF 1108 96PbF2-10SrF2-4KF 1108 96PbF2-8SrF2-4KF			4100	
76PbF2-20BaF2-4RbF		76PbF2-20CaF2-4RbF	5200	
81PbF2-15SrF2-4KBr 5200 81PbF2-15SrF2-4K2CO3 7100 81PbF2-15SrF2-4K2SO4 8500 76PbF2-20SrF2-4KBr 7500 76PbF2-20SrF2-4KBr 7500 76PbF2-20SrF2-4K2CO3 9800 76PbF2-20SrF2-4K2SO4 18400 96PbF2-2CaF2-2KF 1326 94PbF2-2CaF2-3KF 766 94PbF2-2CaF2-3KF 766 94PbF2-2CaF2-3KF 642 95PbF2-2CaF2-3KF 642 95PbF2-2CaF2-3KF 1134 94PbF2-1CaF2-5RbC1 3450 96PbF2-2MgF2-2KF 3630 94PbF2-1MgF2-5KF 2430 0 94PbF2-1MgF2-5KF 108 96PbF2-2MgF2-2KCO3 1047 94PbF2-1MgF2-5K2CO3 1047 94PbF2-1MgF2-5K2CO3 1161 88PbF2-8MgF2-4KF 26400 86PbF2-10MgF2-4KF 21900 76PbF2-2OMgF2-4KF 21900 90PbF2-SSrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 1405 96PbF2-10SrF2-2K2CO3 1805 86PbF2-10SrF2-2K2CO3 1078 86PbF2-10SrF2-2K2CO3 1805 86PbF2-10SrF2-2K2CO3 1405 96PbF2-2Sr(NO3)2-4KNO3 8290 86PbF2-10SrF2-4KF 857 90PbF2-8SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-8SrF2-4KNO1 1900 88PbF2-8SrF2-4KF 2500 88PbF2-8SrF2-4KF 2500 88PbF2-8SrF2-4KF 2500 88PbF2-8SrF2-4KF 2500 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KF 1050 0 88PbF2-8SrF2-4KF 1050 0 88PbF2-8BaF2-4KF		-	6500	
81PbF2-15SrF2-4K2CO3 81PbF2-15SrF2-4K2CO3 76PbF2-20SrF2-4KBr 7500 76PbF2-20SrF2-4KBr 76PbF2-20SrF2-4KBr 76PbF2-20SrF2-4K2SO4 8500 76PbF2-20SrF2-4K2CO3 9800 76PbF2-20SrF2-4K2SO4 18400 96PbF2-2CaF2-2KF 94PbF2-3CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-3KF 95PbF2-3CaF2-4KF 95PbF2-3CaF2-4KF 1134 94PbF2-1CaF2-5RbCl 96PbF2-2MgF2-2KF 3630 94PbF2-1MgF2-5KF 1108 96PbF2-2MgF2-4KF 96PbF2-2MgF2-4KF 96PbF2-2MgF2-4KF 108 89PbF2-8MgF2-4KF 26400 88PbF2-8MgF2-4KF 86PbF2-10MgF2-4KF 26400 86PbF2-2MgF2-4KF 90PbF2-2SrF2-2K2CO3 1161 88PbF2-8MgF2-4KF 90PbF2-2SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 1607 96PbF2-2Sr(NO3)2-4KNO3 86PbF2-10SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-8SrF2-4KSCO 38PbF2-8SrF2-4KF 1034 94.5PbF2-8SrF2-4KSCO 38PbF2-8SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 98PbF2-8SrF2-4KSCO 38PbF2-8SrF2-4KCCO 38PbF2-8SrF2-4KCCO 38PbF2-8SrF2-4KCCO 38PbF2-8SrF2-4KCCO3 1104 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-8SrF2-4KCCO3 11700 88PbF2-8SrF2-4KCCO3 1700 88PbF2-8SrF2-4KCCO3 1700 88PbF2-8SrF2-4KCCO3 88PbF2-8BaF2-4KCCO3 88PbF2-8BaF2-4KCCCO3 88PbF2-8Ba			5200	
\$1PbF2-15SrF2-4K2SO4 76PbF2-20SrF2-4KBr 7500 76PbF2-20SrF2-4K2CO3 9800 76PbF2-20SrF2-4K2SO4 9800 76PbF2-20SrF2-4K2SO4 18400 96PbF2-2CaF2-2KF 1326 94PbF2-3CaF2-3KF 59PbF2-3CaF2-3KF 59PbF2-3CaF2-3KF 642 95PbF2-3CaF2-4KF 642 95PbF2-3CaF2-2KF 1134 94PbF2-1CaF2-5RbCl 96PbF2-2MgF2-2KF 3630 94PbF2-1MgF2-5KF 0400 94PbF2-2MgF2-4KF 1108 96PbF2-2MgF2-4KF 109 94PbF2-1MgF2-5KCO3 94PbF2-1MgF2-5K2CO3 94PbF2-1MgF2-4K2CO3 88PbF2-10MgF2-4KF 88PbF2-8MgF2-4KF 88PbF2-8MgF2-4KF 88PbF2-8SrF2-2K2CO3 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 90PbF2-5SrF2-2K2CO3 90PbF2-5SrF2-2K2CO3 90PbF2-5SrF2-2K2CO3 86PbF2-10CaF2-2K2CO3 86PbF2-10CaF2-2K2CO3 86PbF2-10CaF2-2K2CO3 86PbF2-10CaF2-2K2CO3 86PbF2-10SrF2-2K2CO3 1078 86PbF2-10SrF2-2K2CO3 1078 86PbF2-10SrF2-2K2CO3 1078 86PbF2-10SrF2-4KP 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 988PbF2-8SrF2-4KCI 20000 88PbF2-8SrF2-4KCI 20000 88PbF2-8BaF2-4KCI 20000	_		7100	
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76PbF2-20SrF2-4K2CO3 9800 76PbF2-20SrF2-4K2SO4 18400 96PbF2-2CaF2-2KF 1326 94PbF2-3CaF2-3KF 827 5 95PbF2-2CaF2-3KF 642 95PbF2-2CaF2-3KF 642 95PbF2-3CaF2-3KF 642 95PbF2-3CaF2-3KF 642 95PbF2-3CaF2-3KF 642 95PbF2-3CaF2-3KF 642 95PbF2-3CaF2-3KF 642 95PbF2-3CaF2-2KF 1134 94PbF2-1CaF2-5RbC1 3450 96PbF2-2MgF2-2KF 3630 94PbF2-1MgF2-5KF 2430 94PbF2-1MgF2-5KF 1108 96PbF2-2MgF2-2KF 1108 96PbF2-2MgF2-2KCO3 4400 94PbF2-1MgF2-5K2CO3 1047 94PbF2-1MgF2-5K2CO3 1047 94PbF2-1MgF2-4K2CO3 1161 88PbF2-8MgF2-4KF 26400 86PbF2-10MgF2-4KF 21900 76PbF2-20MgF2-4KF 21900 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-5SrF2-2K2CO3 1970 90PbF2-5SrF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 1405 96PbF2-10SrF2-2K2CO3 1405 96PbF2-10SrF2-4KNO3 1078 86PbF2-10SrF2-4KNO3 1450 86PbF2-10SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-8SrF2-4KC0 2000 88PbF2-8SrF2-4KC0 3 1900 88PbF2-8SrF2-4KC0 3 1700 88PbF2-8SrF2-4KD0 5900 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4KF		,	7500	
76PbF2-20SrF2-4K2SO4 18400 96PbF2-2CaF2-2KF 1326 94PbF2-3CaF2-3KF 827 5 95PbF2-3CaF2-3KF 766 94PbF2-2CaF2-3KF 766 94PbF2-2CaF2-4KF 642 95PbF2-3CaF2-4KF 1134 94PbF2-1CaF2-5RbCl 3450 96PbF2-2MgF2-2KF 3630 94PbF2-1MgF2-5KF 2430 0 94PbF2-2MgF2-4KF 1108 96PbF2-2MgF2-4KF 1108 96PbF2-2MgF2-4KF 1108 96PbF2-1MgF2-5K2CO3 1047 94PbF2-1MgF2-5K2CO3 1647 94PbF2-1MgF2-4KF 26400 86PbF2-10MgF2-4KF 21900 76PbF2-25MgF2-4KF 3680 86PbF2-10MgF2-4KF 3690 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-5SrF2-5KF 848 88PbF2-10CaF2-2K2CO3 1970 90PbF2-5SrF2-4K2CO3 1815 86PbF2-10SrF2-4K2CO3 1078 86PbF2-10SrF2-4KNO3 1078 86PbF2-10SrF2-4KNO3 1078 86PbF2-10SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0K2CO3 1900 88PbF2-8SrF2-4KNO3 1900 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KD0 1700 88PbF2-8SrF2-4KBF 2500 88PbF2-8SrF2-4KBF 2500 88PbF2-8SrF2-4KBF 2500 88PbF2-8SrF2-4KBF 2500 88PbF2-8SrF2-4KBF 1050 0 88PbF2-8BaF2-4KF			9800	
96PbF2-2CaF2-2KF			18400	
5 95PbF ₂ -2CaF ₂ -3KF			1326	
94PbF2-2CaF2-4KF 95PbF2-3CaF2-2KF 95PbF2-3CaF2-2KF 95PbF2-1CaF2-5RbCl 96PbF2-2MgF2-2KF 96PbF2-2MgF2-2KF 96PbF2-2MgF2-2KF 96PbF2-1MgF2-5KF 96PbF2-2MgF2-2KZCO3 94PbF2-1MgF2-5K2CO3 94PbF2-1MgF2-5K2CO3 94PbF2-1MgF2-4KF 1108 96PbF2-1MgF2-4KF 26400 96PbF2-1MgF2-4KF 26400 86PbF2-10MgF2-4KF 21900 76PbF2-2OMgF2-4KF 21900 76PbF2-2OMgF2-4KF 88PbF2-8SrF2-2K2CO3 90PbF2-5SrF2-5KF 88 88 88 88 88 88 88 88 88 88 88 88 88			827	
95PbF ₂ -3CaF ₂ -2KF 1134 94PbF ₂ -1CaF ₂ -5RbCl 3450 96PbF ₂ -2MgF ₂ -2KF 3630 94PbF ₂ -1MgF ₂ -5KF 2430 0 94PbF ₂ -2MgF ₂ -4KF 1108 96PbF ₂ -2MgF ₂ -2K ₂ CO ₃ 4400 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -4K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -20MgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8S ₁ F ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8S ₁ F ₂ -2K ₂ CO ₃ 1202 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1078 86PbF ₂ -10SrF ₂ -4KNO ₃ 1078 86PbF ₂ -10SrF ₂ -4KNO ₃ 1078 86PbF ₂ -10SrF ₂ -4KNO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KO ₃ 1900 88PbF ₂ -8SrF ₂ -4KO ₃ 1900 88PbF ₂ -8SrF ₂ -4KO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8SaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 1700	5	95PbF ₂ -2CaF ₂ -3KF	766	
94PbF ₂ -1CaF ₂ -5RbCl 3450 96PbF ₂ -2MgF ₂ -2KF 3630 94PbF ₂ -1MgF ₂ -5KF 2430 0 94PbF ₂ -2MgF ₂ -2K ₂ CO ₃ 4400 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -4K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -20MgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1815 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1815 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 0 86PbF ₂ -1Sr ₂ -2K ₂ CO ₃ 1450 96PbF ₂ -2Sr(NO ₃) ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ -4K ₂ CO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 58PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1900 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1900 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8SaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 15900 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 5900 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 5900		94PbF ₂ -2CaF ₂ -4KF	642	
96PbF ₂ -2MgF ₂ -2KF 94PbF ₂ -1MgF ₂ -5KF 0 94PbF ₂ -2MgF ₂ -4KF 1108 96PbF ₂ -2MgF ₂ -2K ₂ CO ₃ 4400 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -2OMgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1078 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 86PbF ₂ -10SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -8SrF ₂ -4KNO ₃ 88PbF ₂ -8SrF ₂ -4KDO ₃ 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8SrF ₂ -4KF		95PbF ₂ -3CaF ₂ -2KF	1134	
96PbF ₂ -2MgF ₂ -2KF 94PbF ₂ -1MgF ₂ -5KF 0 94PbF ₂ -2MgF ₂ -4KF 1108 96PbF ₂ -2MgF ₂ -2K ₂ CO ₃ 4400 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -2OMgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1078 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 86PbF ₂ -10SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -8SrF ₂ -4KNO ₃ 88PbF ₂ -8SrF ₂ -4KDO ₃ 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8SrF ₂ -4KF		94PbF ₂ -1CaF ₂ -5RbCl	3450	
94PbF ₂ -1MgF ₂ -5KF 94PbF ₂ -2MgF ₂ -4KF 96PbF ₂ -2MgF ₂ -2K ₂ CO ₃ 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -4K ₂ CO ₃ 86PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 76PbF ₂ -2OMgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 86PbF ₂ -10SrP ₂ -2K ₂ CO ₃ 86PbF ₂ -10SrP ₂ -2K ₂ CO ₃ 86PbF ₂ -10SrP ₂ -2K ₂ CO ₃ 86PbF ₂ -10SrF ₂ -4KNO ₃ 86PbF ₂ -10SrF ₂ -4KNO ₃ *88PbF ₂ -8SrF ₂ -4KF 90PbF ₂ -6SrF ₂ -4KF 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 88PbF ₂ -8SrF ₂ -4KDO ₃ 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8CaF ₂ -4CaF ₂ -4SrF ₂ -4KF		_ _	3630	
96PbF ₂ -2MgF ₂ -2K ₂ CO ₃ 4400 94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -4K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -20MgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1202 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1405 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 0 86PbF ₂ -10SrF ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ -4KNO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 857 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 5900 88PbF ₂ -8CaF ₂ -4K ₂ CO ₃ 5900 88PbF ₂ -8CaF ₂ -4K ₂ CO ₄ 5900		$94PbF_2-1MgF_2-5KF$	2430	
94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -4K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -20MgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1202 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1815 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 0 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 8290 86PbF ₂ -10SrF ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KC1 20000 88PbF ₂ -8SrF ₂ -4KC1 20000 88PbF ₂ -8SrF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000	0		1108	
94PbF ₂ -1MgF ₂ -5K ₂ CO ₃ 1047 94PbF ₂ -1MgF ₂ -4K ₂ CO ₃ 1161 88PbF ₂ -8MgF ₂ -4KF 26400 86PbF ₂ -10MgF ₂ -4KF 21900 5 76PbF ₂ -20MgF ₂ -4KF 40200 90PbF ₂ -5SrF ₂ -5KF 848 88PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1970 90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1202 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1815 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 0 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 8290 86PbF ₂ -10SrF ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KC1 20000 88PbF ₂ -8SrF ₂ -4KC1 20000 88PbF ₂ -8SrF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000	•	96PbF ₂ -2MgF ₂ -2K ₂ CO ₃	4400	
88PbF2-8MgF2-4KF 26400 86PbF2-10MgF2-4KF 21900 5 76PbF2-20MgF2-4KF 40200 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1202 86PbF2-10CaF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 1405 96PbF2-2Sr(NO3)2-2KNO3 1078 96PbF2-2Sr(NO3)2-2KNO3 1078 96PbF2-10SrF2-4KNO3 8290 86PbF2-10SrF2-4KNO3 1450 *88PbF2-8SrF2-4KF 857 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0K2CO3 1164 5 88PbF2-8SrF2-4KNO3 1900 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4KBr 2500 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4K2SO4 5900 88PbF2-4CaF2-4SrF2-4KF 4000			1047	
86PbF2-10MgF2-4KF 76PbF2-20MgF2-4KF 848 88PbF2-8SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 90PbF2-8SrF2-2K2CO3 1202 86PbF2-10CaF2-2K2CO3 86PbF2-10SrF2-2K2CO3 1405 96PbF2-2Sr(NO3)2-2KNO3 86PbF2-10Sr(NO3)2-4KNO3 86PbF2-10SrF24KNO3 1450 *88PbF2-8SrF2-4KF 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 94.5PbF2-0.5CaSO4-5.0K2CO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 88PbF2-8SrF2-4KO3 1900 88PbF2-8SrF2-4KO3 1900 88PbF2-8SrF2-4KO3 1900 88PbF2-8SrF2-4KO3 1900 88PbF2-8SrF2-4KO3 1900 88PbF2-8SrF2-4KD03 1700 88PbF2-8SrF2-4KF 1050 88PbF2-8BaF2-4KF 1050 88PbF2-8BaF2-4KF			1161	
5 76PbF2-20MgF2-4KF 40200 90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1202 86PbF2-10CaF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 1405 96PbF2-2Sr(NO3)2-2KNO3 1078 0 86PbF2-10Sr(NO3)2-2KNO3 8290 86PbF2-10SrF24KNO3 1450 *88PbF2-8SrF2-4KF 857 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0K2CO3 1164 5 88PbF2-8SrF2-4K2SO4 5700 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4KQCO3 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4KF 5900 88PbF2-8BaF2-4CaF2-4SrF2-4KF 4000		88PbF2-8MgF2-4KF	26400	
90PbF2-5SrF2-5KF 848 88PbF2-8SrF2-2K2CO3 1970 90PbF2-8SrF2-2K2CO3 1202 86PbF2-10CaF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 1405 0 96PbF2-2Sr(NO3)2-2KNO3 1078 0 86PbF2-10Sr(NO3)2-4KNO3 8290 86PbF2-10SrF24KNO3 1450 **88PbF2-8SrF2-4KF 857 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-8SrF2-4K2SO4 5700 88PbF2-8SrF2-4KB01 1900 88PbF2-8SrF2-4KB01 20000 88PbF2-8SrF2-4KB01 2500 88PbF2-8SrF2-4KB01 1700 88PbF2-8SrF2-4KB01 2500 88PbF2-8SrF2-4KB01 1700 88PbF2-8SrF2-4KB01 1700 88PbF2-8SrF2-4KB01 1700 88PbF2-8SrF2-4KB01 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4KF		86PbF2-10MgF2-4KF	21900	
90PbF2-5SrF2-5KF 888PbF2-8SrF2-2K2CO3 90PbF2-8SrF2-2K2CO3 1202 86PbF2-10CaF2-2K2CO3 86PbF2-10SrF2-2K2CO3 1815 86PbF2-10SrF2-2K2CO3 96PbF2-2Sr(NO3)2-2KNO3 86PbF2-10Sr(NO3)2-4KNO3 86PbF2-10SrF2-4KNO3 86PbF2-10SrF2-4KF 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-8SrF2-4KNO3 88PbF2-8SrF2-4KNO3 1900 88PbF2-8SrF2-4KC1 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4KBr 1050 88PbF2-8SrF2-4KC1 9000 88PbF2-8SrF2-4KBr 9000 98PbF2-8SrF2-4KBR 9000 98PbF2-8SrF2-4KBR 9000 98PbF2-8SrF2-4KBR 9000 98PbF2-8BaF2-4KF	5	76PbF2-20MgF2-4KF	40200	
90PbF ₂ -8SrF ₂ -2K ₂ CO ₃ 1202 86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1815 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 0 86PbF ₂ -10Sr(NO ₃) ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ 4KNO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4KG 2500 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 1050	,	90PbF2-5SrF2-5KF	848	
86PbF ₂ -10CaF ₂ -2K ₂ CO ₃ 1405 86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 86PbF ₂ 10Sr(NO ₃) ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ 4KNO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 1050		$88PbF_2-8SrF_2-2K_2CO_3$	1970	
86PbF ₂ -10SrF ₂ -2K ₂ CO ₃ 1405 96PbF ₂ -2Sr(NO ₃) ₂ -2KNO ₃ 1078 86PbF ₂ 10Sr(NO ₃) ₂ -4KNO ₃ 8290 86PbF ₂ -10SrF ₂ 4KNO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF		$90PbF_2-8SrF_2-2K_2CO_3$	1202	
0 96PbF2-2Sr(NO3)2-2KNO3 1078 86PbF210Sr(NO3)2-4KNO3 8290 86PbF2-10SrF24KNO3 1450 *88PbF2-8SrF2-4KF 857 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0K2CO3 1164 5 88PbF2-8SrF2-4K2SO4 5700 88PbF2-8SrF2-4KNO3 1900 88PbF2-8SrF2-4KCl 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4KQCO3 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4KF 5900 0 88PbF2-4CaF2-4SrF2-4KF 4000		86PbF2-10CaF2-2K2CO3	1815	
0 86PbF210Sr(NO3)2-4KNO3 8290 86PbF2-10SrF24KNO3 1450 *88PbF2-8SrF2-4KF 857 90PbF2-6SrF2-4KF 1034 94.5PbF2-0.5CaSO4-5.0KF 1136 94.5PbF2-0.5CaSO4-5.0K2CO3 1164 5 88PbF2-8SrF2-4K2SO4 5700 88PbF2-8SrF2-4KNO3 1900 88PbF2-8SrF2-4KCl 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4K2CO3 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4K2SO4 5900 88PbF2-4CaF2-4SrF2-4KF 4000	^	86PbF2-10SrF2-2K2CO3	1405	
86PbF ₂ -10SrF ₂ 4KNO ₃ 1450 *88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4KBr 1700 88PbF ₂ -8SrF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900		96PbF2-2Sr(NO ₃)2-2KNO ₃	1078	
*88PbF ₂ -8SrF ₂ -4KF 857 90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -8CaF ₂ -4K ₂ SO ₄ 5900	U	$86PbF_210Sr(NO_3)_2-4KNO_3$	8290	
90PbF ₂ -6SrF ₂ -4KF 1034 94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000		86PbF2-10SrF24KNO3	1450	
94.5PbF ₂ -0.5CaSO ₄ -5.0KF 1136 94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4KBr 1050 88PbF ₂ -8BaF ₂ -4KF 1050 88PbF ₂ -8BaF ₂ -4KF 4000		*88PbF ₂ -8SrF ₂ -4KF	857	
94.5PbF ₂ -0.5CaSO ₄ -5.0K ₂ CO ₃ 1164 5 88PbF ₂ -8SrF ₂ -4K ₂ SO ₄ 5700 88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4KF 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000		90PbF2-6SrF2-4KF	1034	
5 88PbF2-8SrF2-4K2SO4 5700 88PbF2-8SrF2-4KNO3 1900 88PbF2-8SrF2-4KCl 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4K2CO3 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4K2SO4 5900 88PbF2-4CaF2-4SrF2-4KF 4000	5	94.5PbF ₂ -0.5CaSO ₄ -5.0KF	1136	
88PbF ₂ -8SrF ₂ -4KNO ₃ 1900 88PbF ₂ -8SrF ₂ -4KCl 20000 88PbF ₂ -8SrF ₂ -4KBr 2500 88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000			1164	
88PbF2-8SrF2-4KCl 20000 88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4K2CO3 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4K2SO4 5900 88PbF2-4CaF2-4SrF2-4KF 4000		$88PbF_2-8SrF_2-4K_2SO_4$	5700	
88PbF2-8SrF2-4KBr 2500 88PbF2-8SrF2-4K2CO3 1700 88PbF2-8BaF2-4KF 1050 0 88PbF2-8BaF2-4K2SO4 5900 88PbF2-4CaF2-4SrF2-4KF 4000				
88PbF ₂ -8SrF ₂ -4K ₂ CO ₃ 1700 88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000		-		
88PbF ₂ -8BaF ₂ -4KF 1050 0 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000				
0 88PbF ₂ -8BaF ₂ -4K ₂ SO ₄ 5900 88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000				
88PbF ₂ -4CaF ₂ -4SrF ₂ -4KF 4000		-		
88PbF ₂ -4CaF ₂ -4SrF ₂ -4K ₂ SO ₄ 15600				
		88PbF ₂ -4CaF ₂ -4SrF ₂ -4K ₂ SO ₄	15600	

*The ionically conducting product formed from this ternary mixture was analyzed and found to contain the following: 78.63 wt./percent lead, 3.07 wt./percent strontium, 15.97 wt./percent fluorine and 0.60 wt./percent potassium.

EXAMPLE II

A lead disc anode, a solid electrolyte made from the molar mixture of 88PbF₂-8SrF₂-4KF and a cathode 0 consisting of a 1:1 molar mixture of MnF3 and PbO2 which was further diluted with about 30 wt. % of the electrolyte was compressed together in a cavity of 1-cm² cross section at about 12,000 psi. The open circuit voltage of the cell so produced was 1.60 volts and when 5 discharged across a 500-K-ohm resistor, the initial closed circuit voltage was 1.56 volts.

EXAMPLE III

A cell was prepared as in Example II with the exception that the cathode was a 1:1 molar mixture of CoF₃ and PbO₂. The open circuit voltage of the cell so produced was 1.9 volts and fell to 1.88 volts initially when a 100-K-ohm resistor was connected across the cell.

EXAMPLE IV

To further test the solid state electrolyte of this invention in a cell, a sheet-lead anode, a solid electrolyte made from the molar mixture 88PbF2-8SrF2-4KF and a

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lead dioxide (PbO₂) cathode were assembled together to form a cell. The open circuit voltage of the cell so produced was 1.192 volts and when discharged across a 500-K-Ohm resistor, the initial closed circuit voltage was 1.170 volts. Under this load condition, the initial 5 current density was calculated to be $2.3 \,\mu\text{A/cm}^2$. Thus the solid state electrolyte of this invention is admirably suited for battery applications.

EXAMPLE V

A cell was constructed as described in Example IV with the exception that the cathode was electrolytic manganese dioxide mixed with the electrolyte made from the molar mixture 88PbF₂-8 SrF₂-4KF. The open circuit voltage of the cell so produced was 1.088 volts 15 and when discharged across a 500-K-ohm resistor, the initial closed circuit voltage was 1.082 volts.

EXAMPLE VI

Several additional cells were prepared using an anode 20 of lead, a solid electrolyte made from the molar mixture 88PbF₂-8SrF₂-4FK and a cathode as shown in Table II. The open circuit voltage of each cell produced was measured and is shown in Table II. From the data shown in Table II it is evident that the solid state electrolytes of this invention can be admirably suited for battery applications.

TABLE II

Cathode Material	O.C.V. (Volts)	Cathode Material	O.C.V. (Volts)
HgF ₂ + graphite	1.20	CF_x	0.50
AgF ₂ + graphite	1.90	EMD(MnO ₂)/HgO	1.05
BiF ₃ + graphite	0.86	CoF ₃ .MnO ₂	1.23
CoF ₃ + graphite	1.35	BrF ₃ .PbO ₂	1.11
MnF ₃ + graphite	0.26	MnF ₃ .PbO ₂	1.71
PbO ₂	1.04	CoF ₃ .PbO ₂	1.90
YF3 + graphite	0.95	TaF ₅ .PbO ₂	1.80
AuF ₃ + graphite	1.24	V_2O_5	0.85
FeF ₂ + graphite	1.04	FeS ₂	0.53
FeF ₃ + graphite	0.66	WO_3	0.185
EMD(MnO ₂)	1.09	CoF ₃ .HlO ₃	1.625
MnF ₃ /MnO ₂	1.30	TaF ₅ + graphite	0.69
$CuF_2 + graphite$	0.80	TaF ₅ .MnF ₃ + graphite	1.52

As evident from the examples above the solid state electrolyte of this invention can be used with various cell systems employing an anode such as lead or any metal more noble than lead and fluoride-containing solid cathodes.

What is claimed is:

21. A solid state cell electrolyte comprising an ionically conducting produce of a fused ternary mixture of lead fluoride, an alkali salt selected from the group consisting of sodium, potassium rubidium and cesium salts in a range of between about 1.0 and about 15.0 mole percent and a fluoride, nitrate or sulfate of magnesium, calcium, strontium or barium in a range between about 1 and about 40 mole percent.

[2. The solid state cell electrolyte of claim 1 wherein the alkali salt is selected from the group consisting of

potassium fluoride, rubidium fluoride, cesium fluoride, potassium carbonate, potassium sulfate and potassium

nitrate.

[3. The solid state cell electrolyte of claim 1 wherein the fluoride is selected from the group consisting of strontium fluoride, calcium fluoride, barium fluoride and magnesium fluoride.]

[4. The solid state cell electrolyte of claim 1 wherein the nitrate is selected from the group consisting of cal-

cium nitrate and strontium nitrate.]

[5. The solid state cell electrolyte of claim 1 wherein the sulfate is selected from the group consisting of calcium sulfate, barium sulfate and strontium sulfate.]

[6. The solid state electrolyte of claim 1 wherein the ionically conducting produce is formed from the fused ternary mixture 88PbF₂-8SrF₂-4KF.]

[7. The solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the fused ternary mixture 94PbF₂-3CaF₂-3KF.]

[8. The solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the fused ternary mixture 95PbF₂-2CaF₂-3KF.]

[9. The solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the fused ternary mixture 94PbF₂-2CaF₂-4KF.]

[10. The solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the fused ternary mixture 86PbF₂-10SrF₂-4KF.]

[11. The solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the fused ternary mixture 86PbF₂-10BaF₂-4KF.]

[12. The solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the state of the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the state of the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the state of the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionically conducting product is formed from the solid state electrolyte of claim 1 wherein the ionical state electrolyte of claim 1 wherein the ionical state electrolyte of claim 1 wherein the ionical state electrolyte of claim 1 wherein 1 wherei

13. A solid state cell electrolyte comprising an ionically conducting product of a fused ternary mixture of lead fluoride, an alkali salt selected from the group consisting of sodium salts, cesium salts and nonfluoride-containing salts of potassium and rubidium in a range of between about 1.0 and about 15.0 mole percent and a fluoride, nitrate or sulfate of magnesium, calcium, strontium or barium in a range of between about 1 and about 40 mole percent.

14. The solid state cell electrolyte of claim 13 wherein the alkali salt is selected from the group consisting of cesium fluoride, potassium carbonate, potassium sulfate and

potassium nitrate.

15. The solid state cell electrolyte of claim 13 wherein the fluoride is selected from the group consisting of strontium fluoride, calcium fluoride, barium fluoride and magnesium fluoride.

16. The solid state cell electrolyte of claim 13 wherein the nitrate is selected from the group consisting of calcium nitrate and strontium nitrate.

17. The solid state cell electrolyte of claim 13 wherein the sulfate is selected from the group consisting of calcium sulfate, barium sulfate and strontium sulfate.

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