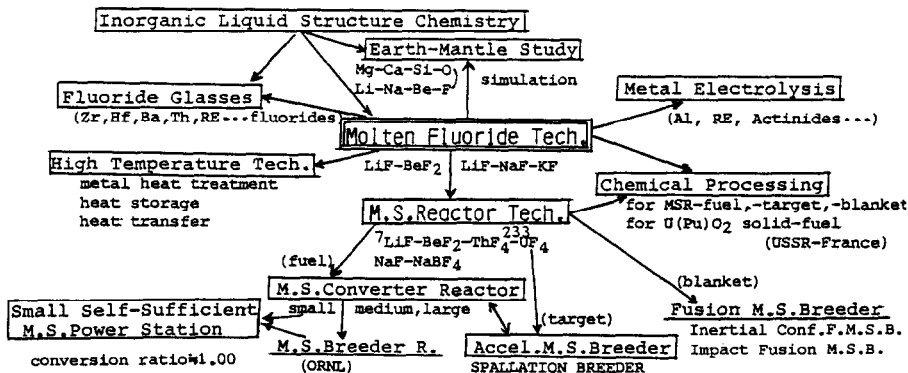


APPLICATIONS AND FUTURE OF MOLTEN FLUORIDES

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Fluorides of the 1st~4th group metallic elements in Periodic Table are thermo-chemically most stable compounds. Therefore, molten salts composed of these fluoride mixtures are most typical ionic liquids useful for several industrial purposes. (A) One of the most significant past and present applications is the salt bath (NaF-Na₃AlF₆) for aluminum electrolysis invented by young French and American engineers just 100 years ago. (B) One of the most promising and ambitious future applications might be the utilization of ⁷LiF-BeF₂-ThF₄-UF₄(PuF₃) or similar for several nuclear energy systems (Molten Salt Reactors), including fission, fusion, spallation and their synergetic systems. The above salts are excellent multipurpose-medium suitable for heat transfer, nuclear reaction and engineering (no radiation-damage) and chemical processing by single phase. The following are typical proposals for MSRs : (B1) MSBR(breeder reactor)(Oak Ridge N.L.) was a brilliant historical project. However, it has to have (a)larger electric capacity, (b)core-graphite exchanging over a period of years, (c)continuous chemical-processing most difficult to develop, and (d)still unsatisfactory slow breeding. (B2) At first, small MSRC(converter reactor)power stations should be developed not only eliminating the problems (a),(b)&(c) but also keeping the conversion-ratio ≈ 1.00 ideal for operation and non-nuclear proliferation as predicted by our 150MWe-MSRC design. (B3) Afterwards, larger MSRC power stations could be developed. (B4) As a next project for 21st century, a high-performance fissile material breeder AMSB Accelerator(Spallation)M.S.Breeder should be developed applying a big molten salt target. synergetic system composed of centralized AMSBs and batch-chemical process plants and many local small or large MSRCs could distribute a simple and economical molten-fluoride Th fuel-cycle (useful for trans-U elements incineration and non-nuclear proliferation) all over the world. (C) The above solvent LiF-BeF₂ is extremely similar to MgO-SiO₂ melt in structure and physical properties in reduced-temperature scale. Furthermore, LiF-NaF-BeF₂ melt is similar to MgO-CaO-SiO₂ melt, which is the main constituent of earth-mantle. The latter study will be preceded by LiF-NaF-BeF₂ melt in lower temperature & pressure. Therefore, MSRs might be said to be the 'simulation of earth-mantle.'



1- STRUCTURE CHEMISTRY OF MOLTEN SALTS

- K.Furukawa: Discuss. Faraday Soc., 32 (1961) 53.
 " : Reports on Progress in Phys., 25 (1962) 395.
 several, in recent J. Chem. Soc. Faraday Trans. I, II (--1980--).
 H. Ohno & K. Furukawa: Adv. in Molten Salt Chem., 7 (1987) in prep.

2- NUCLEAR APPLICATIONS OF MOLTEN FLUORIDES

- K.Furukawa: Atomkernenergie/Kerntech., 44 (1984) 42.
 " : 7th Miami Int. Conf. Alternative Energy Sources,
 (Dec. 1985, Miami)--two reports--
 " et al. : 4th Int. Conf. Emerging Nuclear Energy Systems
 (June/July 1986, Madrid).

3- SIMILARITY OF MOLTEN FLUORO-BERYLLATES AND SILICATES

- K.Furukawa & H. Ohno: TRANS. JAPAN Inst. Metals, 19 (1978) 553
 K.Furukawa: 'Koobutugaku-zasshi' (J. of Mineralogy), 14
 (sp. II) (1980) 34 in (Japanese).

cf..

- M.W. Rosenthal et al. 'The Development Status of Molten-Salt Breeder Reactors', ORNL-4812 (1972).

- EDF-CEA Reports : Vol I: Analysis of Molten Salt Breeder Reactor;
 CEA-Note n° 1963
 Vol II: Comments & proposals about MSBR;
 CEA-Note n° 2341
 Vol III: Synthesis of the MSR studies;
 CEA-Note n° 2381

- D.E. Lillenthal, 'Atomic Energy : A New Start', (Harper & Row, 1980).