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Uranium and fluorine cycles in the nuclear industry

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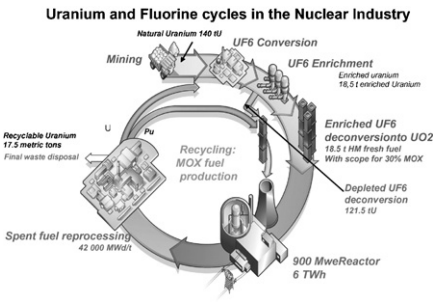

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Reactor physic and reprocessing scheme for innovative molten salt reactor system

S. Delpech[a], E. Merle-Lucotte[b], D. Heuer[b], M. Allibert[b], V. Ghetta[b], C. Le-Brun[b], X. Doligez[b], G. Picard[a]

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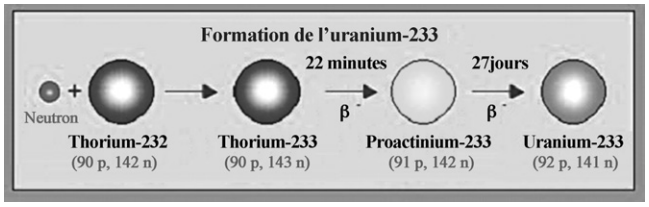
[b]*LPSC, Université Joseph Fourier, In2P3-CNRS, Institut Polytechnique de Grenoble, 53, avenue des Martyrs, F-38026 Grenoble Cedex France*



For a sustainable energy, an innovative concept of thorium molten salt reactor is evaluated. A key issue is the development of a devoted chemical reprocessing of the fluoride liquid fuel in order to assess the reactor performance.

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Potentialities of fluoride-based salts for specific nuclear reprocessing: Overview of the R&D program at CEA

Jérôme Lacquement[a], Hubert Boussier[a], Annabelle Laplace[a], Olivier Conocar[a], Agnès Grandjean[b]

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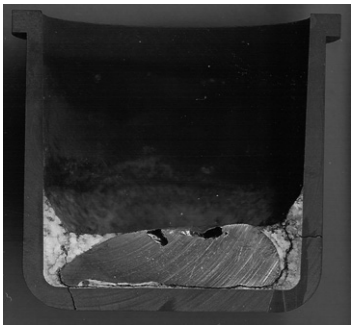
[b]*CEA, DEN/MAR/DTCD/SCDV/LEBV, Bât. 208, BP17171 Bagnols/Ceze, France*

Molten fluorides and liquid metallic solvents (shown in the photograph after cooling) are assessed as interesting media for operating at high temperature separations between actinides and fission products in specific nuclear reprocessing.



doi:10.1016/S0022-1139(08)00346-1

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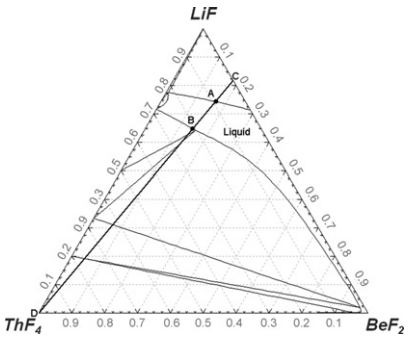
Thermodynamic properties and phase diagrams of fluoride salts for nuclear applications

O. Beneš, R.J.M. Konings

European Commission, Joint Research Centre, Institute for Transuranium Elements, P.O. Box 2340, 76125 Karlsruhe, Germany



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Evaluating physical properties of molten salt reactor fluoride mixtures

Vladimir Khokhlov[a], Victor Ignatiev[b], Valery Afonichkin[a]

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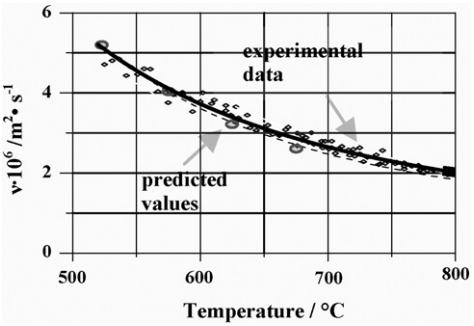
[b]*RRC-Kurchatov Institute, 1, Kurchatov sq., Moscow, Russia*

The properties of multi-component molten fluoride mixtures as fluid fuels and coolants for innovative nuclear power systems are estimated and compared with available experimental data.



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Heat-transport properties of molten fluorides: Determination from first-principles

Mathieu Salanne[a,b], Christian Simon[a,b], Pierre Turq[a,b], Paul A. Madden[c]

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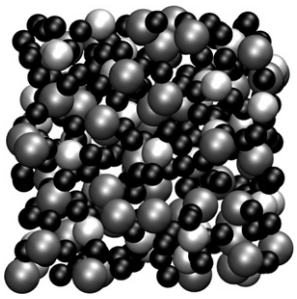
[b]*CNRS, UMR 7612, LI2C, Paris F-75005, France*
[c]*School of Chemistry, University of Edinburgh, Edinburgh EH9 3JJ, UK*



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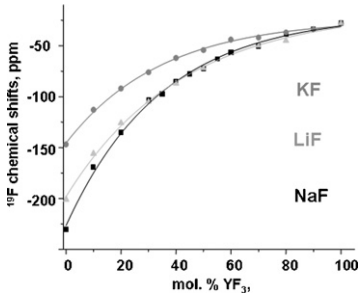
High temperature NMR approach of mixtures of rare earth and alkali fluorides: An insight into the local structure

Catherine Bessada, Aydar Rakhmatullin, Anne-Laure Rollet, Didier Zanghi

CNRS-CEMHTI, 1D Av. de la Recherche Scientifique, 45071 Orleans Cedex 2, France

High temperature ^{19}F and ^{89}Y NMR *in situ* description of the complexes in molten AF–YF_3 mixtures (A = Li, Na, K).



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XAFS analyses of molten metal fluorides

Haruaki Matsuura[a,b,c], Sou Watanabe[a], Hiroshi Akatsuka[a], Yoshihiro Okamoto[d], Ashok K. Adya[e]

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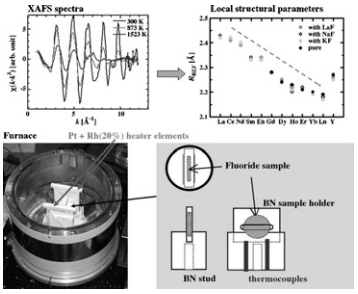
[b]*Conditions Extrêmes et Matériaux: Haute Température et Irradiation, 1D avenue de la recherche scientifique, 45071 Orléans, cedex 2, France*
[c]*le STUDIUM, Institute for advanced studies in region centre, 3D avenue de la recherche scientifique, 45071 Orléans, cedex 2, France*
[d]*Japan Atomic Energy Agency, Kansai Photon Science Institute, Kouto 1-1-1, Sayo-cho, Sayo-gun, Hyogo 679-5148, Japan*
[e]*Condensed Matter Group & BIONTH Centre, School of Contemporary Sciences, University of Abertay Dundee, Bell Street, Dundee DD1 1HG, UK*



The local structural parameters of molten divalent and trivalent fluorides and their mixtures obtained by X-ray absorption fine structure are widely discussed.

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Transport in molten LiF–NaF–ZrF_4 mixtures: A combined computational and experimental approach

Mathieu Salanne[a,b], Christian Simon[a,b], Henri Groult[a,b], Frédéric Lantelme[a,b], Takuya Goto[c], Abdeslam Barhoun[d]

[a]*UPMC Univ Paris 06, UMR 7612, LI2C, F-75005 Paris, France*
[b]*CNRS, UMR 7612, LI2C, F-75005 Paris, France*
[c]*Kyoto University, Graduate School of Energy Science, Department of Fundamental Energy Science, Kyoto 6068501, Japan*
[d]*Université Abdelmalek Essaâdi, Faculté des Sciences, LPCIE, 93000 Tétouan, Morocco*

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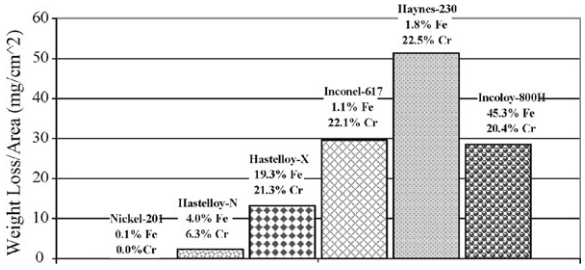
Materials corrosion in molten LiF–NaF–KF salt

Luke C. Olson, James W. Ambrosek, Kumar Sridharan, Mark H. Anderson, Todd R. Allen

Department of Engineering Physics, 1500 Engineering Drive, University of Wisconsin-Madison, Madison, WI 53706, USA



Corrosion tests of high temperature alloys were performed in molten salt, FLiNaK (LiF–NaF–KF:46.5–11.5–42 mol%) at 850 °C for 500 h in sealed graphite crucibles under an argon cover gas with the goal of understanding corrosion mechanisms and ranking these alloys for suitability in a molten salt heat exchanger.

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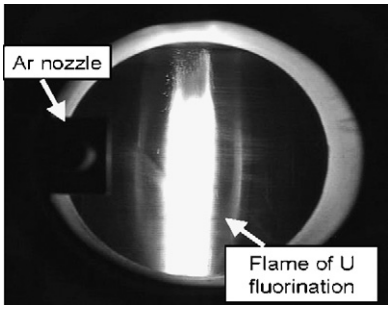
New reprocessing system for spent nuclear reactor fuel using fluoride volatility method

Yuko Kani[a], Akira Sasahira[a], Kuniyoshi Hoshino[b], Fumio Kawamura[b]

[a]*Power & Industrial Systems R&D Laboratory, Hitachi Ltd., 7-2-1 Omika, Hitachi, Ibaraki 319-1221, Japan*
[b]*Hitachi Works, Hitachi-GE Nuclear Energy, Ltd., 3-1-1 Saiwai, Hitachi, Ibaraki 317-0073, Japan*



The FLUOREX reprocessing system, which is a hybrid system using fluoride volatility and solvent extraction, has been developed. The technical and engineering feasibilities of the system are confirmed by engineering scale experiments.

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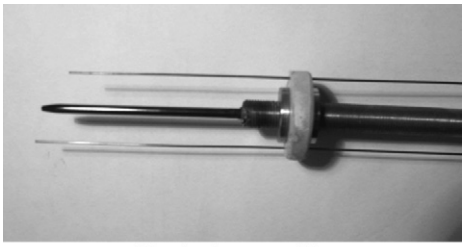
Dynamic reference electrode for investigation of fluoride melts containing beryllium difluoride

Valery K. Afonichkin[a], Andrey L. Bovet[a], Victor V. Ignatiev[c], Alexander V. Panov[b], Vladimir G. Subbotin[b], Alexander I. Surenkov[c], Andrey D. Toropov[b], Aleksey L. Zherebtsov[b]

[a]*Institute of High-Temperature Electrochemistry, Russian Academy of Sciences, Ural Branch, 20 Academicheskaya St., Yekaterinburg 620219, Russia*
[b]*Russian Federal Nuclear Center All-Russian Scientific Research Institute of Technical Physics, Box 245, Snezhinsk 456770, Chelyabinsk Region, Russia*
[c]*Russian Research Center Kurchatov Institute, 1 Kurchatov Square, Moscow 123182, Russia*

The behavior of a new dynamic beryllium reference electrode and device for measurement of a redox potential in a molten mixture Li, Na, Be/F are studied.



The external appearance of the bottom (working) part of the device

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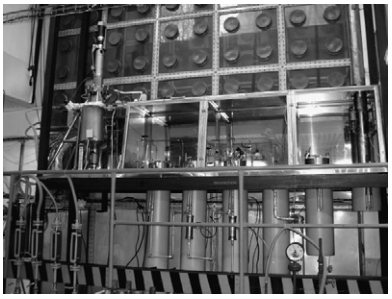
Fluoride volatility method for reprocessing of LWR and FR fuels

Jan Uhlíř, Martin Mareček

Nuclear Research Institute Řež plc, CZ-250 68 Husinec – Řež 130, Czech Republic

Current status of R&D on fluoride volatility method for LWR and FR spent fuel reprocessing is described.



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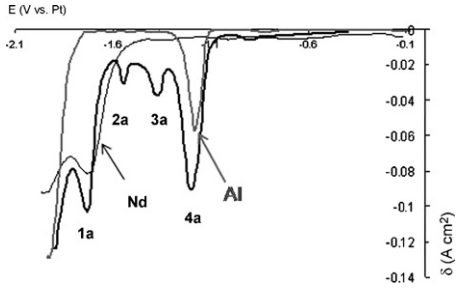
Lanthanides extraction processes in molten fluoride media: Application to nuclear spent fuel reprocessing

P. Taxil, L. Massot, C. Nourry, M. Gibilaro, P. Chamelot, L. Cassayre

Laboratoire de Génie Chimique (LGC), Département Procédés Electrochimiques UMR 5503, Université Paul Sabatier, 31062 Toulouse Cedex 9, France

Overlapping of the neodymium and solvent respective potential ranges, is avoided by co-reduction with Al, which shifts equilibrium potential towards anodic sense, as observed on square wave voltammetry of Nd and Al, where we observe the alloys formation (peaks 2a, 3a and 4a) containing Nd at more positive potentials than pure Nd.



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Selected topics of molten fluorides in the field of nuclear engineering

Takuya Goto, Toshiyuki Nohira, Rika Hagiwara, Yasuhiko Ito

Department of Fundamental Energy Science, Graduate School of Energy Science, Kyoto University, Sakyo, Kyoto 6068501, Japan

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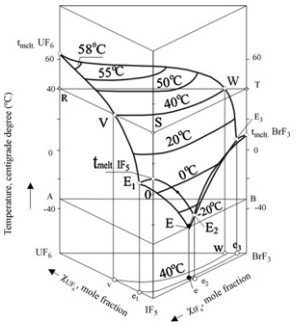
Separation of systems based on uranium hexafluoride and some of halogen fluorides

R.V. Ostvald[a], V.V. Shagalov[a], I.I. Zherin[a], G.N. Amelina[a], V.F. Usov[a], A.I. Rudnikov[b], O.B. Gromov[c]

[a]*Tomsk Polytechnic University, Lenin Avenue 30, Tomsk 634050, Russian Federation*
[b]*Siberian Group of Chemical Enterprise, Kurchatov St. 1, Seversk, Tomsk Region 636000, Russia*
[c]*All-Russian Research Institute of Chemical Technology, Kashirskoye Shosse 33, Moscow 115409, Russia*

The results of experimental study of the phase equilibriums liquid–solid and liquid–vapour in the systems UF_6–BrF_3, UF_6–IF_5, BrF_3–IF_5, UF_6–BrF_3–IF_5 are presented. Also investigation of the sorption and desorption processes of the bromine trifluoride on the sodium fluoride is provided.



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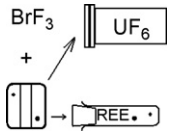
Application of bromine trifluoride for pre-concentration and determination of rare-earth elements in fuel uranium dioxide

V.N. Mitkin, B.M. Shavinsky

Nikolaev Institute of Inorganic Chemistry SB RAS, 3, Lavrentjeva Avenue, Novosibirsk 630090, Russia



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Depleted uranium hexafluoride—The fluorine source for production of the inorganic and organic compounds

V.V. Shatalov, V.A. Seredenko, D.Yu. Kalmakov, A.V. Ivanov, O.B. Gromov, A.V. Parfienov

Federal State Unitary Enterprise "All-Russian Research Institute of Chemical Technology", 33, Kashirskoe Avenue, Moscow 115409, Russia

$$UF_6 + \text{Reducer} \xrightarrow{t} UF_4, U_3O_8 + HF$$

$$UF_6 + ElF_n \xrightarrow{t} UF_4 + ElF_{n+2}$$

$$UF_4 + MO_n \xrightarrow{\text{t, mechanical chemistry}} UO_2 + MF_m$$

$$HF + UO_2 \xrightarrow{t} UF_4 + H_2O$$

$$HF \xrightarrow{\text{Electrolyze}} F_2 + H_2$$