

# Reprocessing of spent nuclear waste using ionic liquids

Korean Journal of Chemical Engineering

September 2010, Volume 27, Issue 5, pp 1360–1365 | Cite as

- Sung Ho Ha (1)
- Russel Navarro Menchavez (2)
- Yoon-Mo Koo (2) Email author (ymkoo@inha.ac.kr)

1. ERC for Advanced Bioseparation Technology, Inha University, , Incheon, Korea
2. Department of Biological Engineering, Inha University, , Incheon, Korea

Invited Review Paper

First Online: 02 September 2010

- 1k Downloads
- [74 Citations](#)

## Abstract

Nuclear power has once again attracted from all over the world due to many factors including the rise in oil process and environmental concerns on greenhouse gas emission resulting in global warming. However, spent fuel from nuclear power reactors is an enormous problem both from radiation hazard and economical point of view. Therefore, this review presents an overview of application of ionic liquids (ILs) in spent fuel reprocessing, particularly in the extraction of high-level radioactive aqueous waste from the processing of nuclear fuel.

## Key words

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our [Privacy Statement](#). You can manage your preferences in [Manage Cookies](#).

› [Manage Cookies](#)

✓ OK

## Preview

## References

- [illegible]

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our [Privacy Statement](#). You can manage your preferences in [Manage Cookies](#).

› **Manage Cookies**

✓ OK

- [Google Scholar](http://scholar.google.com/scholar_lookup?&author=P.%20K.%20Dey&author=N.%20K.%20Bansal&journal=Nucl.%20Eng.%20Des.&volume=236&pages=723&publication_year=2006) ([http://scholar.google.com/scholar\\_lookup?&author=P.%20K.%20Dey&author=N.%20K.%20Bansal&journal=Nucl.%20Eng.%20Des.&volume=236&pages=723&publication\\_year=2006](http://scholar.google.com/scholar_lookup?&author=P.%20K.%20Dey&author=N.%20K.%20Bansal&journal=Nucl.%20Eng.%20Des.&volume=236&pages=723&publication_year=2006))
5. C. L. Riddle, J.D. Baker, J.D. Law, C.A. McGrath, D.H. Meikrantz, B. J. Mincher, D. R. Peterman and T.A. Todd, *Solvent Extr. Ion Exch.*, **23**, 449 (2004).  
[CrossRef](https://doi.org/10.1081/SEI-200058035) (<https://doi.org/10.1081/SEI-200058035>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=C.%20L.%20Riddle&author=J.D.%20Baker&author=J.D.%20Law&author=C.A.%20McGrath&author=D.H.%20Meikrantz&author=B.%20J.%20Mincher&author=D.%20R.%20Peterman&author=T.A.%20Todd&journal=Solvent%20Extr.%20Ion%20Exch.&volume=23&pages=449&publication_year=2004) ([http://scholar.google.com/scholar\\_lookup?&author=C.%20L.%20Riddle&author=J.D.%20Baker&author=J.D.%20Law&author=C.A.%20McGrath&author=D.H.%20Meikrantz&author=B.%20J.%20Mincher&author=D.%20R.%20Peterman&author=T.A.%20Todd&journal=Solvent%20Extr.%20Ion%20Exch.&volume=23&pages=449&publication\\_year=2004](http://scholar.google.com/scholar_lookup?&author=C.%20L.%20Riddle&author=J.D.%20Baker&author=J.D.%20Law&author=C.A.%20McGrath&author=D.H.%20Meikrantz&author=B.%20J.%20Mincher&author=D.%20R.%20Peterman&author=T.A.%20Todd&journal=Solvent%20Extr.%20Ion%20Exch.&volume=23&pages=449&publication_year=2004))
  6. E. P. Horwitz, M. L. Dietz and D. E. Fisher, *Solvent Extr. Ion Exch.*, **9**, 1 (1991).  
[CrossRef](https://doi.org/10.1080/07366299108918039) (<https://doi.org/10.1080/07366299108918039>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=E.%20P.%20Horwitz&author=M.%20L.%20Dietz&author=D.%20E.%20Fisher&journal=Solvent%20Extr.%20Ion%20Exch.&volume=9&pages=1&publication_year=1991) ([http://scholar.google.com/scholar\\_lookup?&author=E.%20P.%20Horwitz&author=M.%20L.%20Dietz&author=D.%20E.%20Fisher&journal=Solvent%20Extr.%20Ion%20Exch.&volume=9&pages=1&publication\\_year=1991](http://scholar.google.com/scholar_lookup?&author=E.%20P.%20Horwitz&author=M.%20L.%20Dietz&author=D.%20E.%20Fisher&journal=Solvent%20Extr.%20Ion%20Exch.&volume=9&pages=1&publication_year=1991))
  7. D. J. Wood, T. J. Tranter and T.A. Todd, *Solvent Extr. Ion Exch.*, **13**, 829 (1995).  
[CrossRef](https://doi.org/10.1080/07366299508918305) (<https://doi.org/10.1080/07366299508918305>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=D.%20J.%20Wood&author=T.%20J.%20Tranter&author=T.A.%20Todd&journal=Solvent%20Extr.%20Ion%20Exch.&volume=13&pages=829&publication_year=1995) ([http://scholar.google.com/scholar\\_lookup?&author=D.%20J.%20Wood&author=T.%20J.%20Tranter&author=T.A.%20Todd&journal=Solvent%20Extr.%20Ion%20Exch.&volume=13&pages=829&publication\\_year=1995](http://scholar.google.com/scholar_lookup?&author=D.%20J.%20Wood&author=T.%20J.%20Tranter&author=T.A.%20Todd&journal=Solvent%20Extr.%20Ion%20Exch.&volume=13&pages=829&publication_year=1995))
  8. J. F. Dozol, N. Simon, V. Lamare, H. Rouquette, S. Eymard, B. Tournois, D. De Marc and R. M. Macias, *Sep. Sci. Technol.*, **34**, 877 (1999).  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=J.%20F.%20Dozol&author=N.%20Simon&author=V.%20Lamare&author=H.%20Rouquette&author=S.%20Eymard&author=B.%20Tournois&author=D.%20Marc&author=R.%20M.%20Macias&journal=Sep.%20Sci.%20Technol.&volume=34&pages=877&publication_year=1999) ([http://scholar.google.com/scholar\\_lookup?&author=J.%20F.%20Dozol&author=N.%20Simon&author=V.%20Lamare&author=H.%20Rouquette&author=S.%20Eymard&author=B.%20Tournois&author=D.%20Marc&author=R.%20M.%20Macias&journal=Sep.%20Sci.%20Technol.&volume=34&pages=877&publication\\_year=1999](http://scholar.google.com/scholar_lookup?&author=J.%20F.%20Dozol&author=N.%20Simon&author=V.%20Lamare&author=H.%20Rouquette&author=S.%20Eymard&author=B.%20Tournois&author=D.%20Marc&author=R.%20M.%20Macias&journal=Sep.%20Sci.%20Technol.&volume=34&pages=877&publication_year=1999))
  9. P.V. Bonnesen, L. H. Delmau, B. A. Moyer and R. A. Leonard, *Solvent Extr. Ion Exch.*, **18**, 1079 (2000).  
[CrossRef](https://doi.org/10.1080/07366290008934723) (<https://doi.org/10.1080/07366290008934723>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=P.V.%20Bonnesen&author=L.%20H.%20Delmau&author=B.%20A.%20Moyer&author=R.%20A.%20Leonard&journal=Solvent%20Extr.%20Ion%20Exch.&volume=18&pages=1079&publication_year=2000) ([http://scholar.google.com/scholar\\_lookup?&author=P.V.%20Bonnesen&author=L.%20H.%20Delmau&author=B.%20A.%20Moyer&author=R.%20A.%20Leonard&journal=Solvent%20Extr.%20Ion%20Exch.&volume=18&pages=1079&publication\\_year=2000](http://scholar.google.com/scholar_lookup?&author=P.V.%20Bonnesen&author=L.%20H.%20Delmau&author=B.%20A.%20Moyer&author=R.%20A.%20Leonard&journal=Solvent%20Extr.%20Ion%20Exch.&volume=18&pages=1079&publication_year=2000))

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our Privacy Statement. You can manage your preferences in Manage Cookies.

› [Manage Cookies](#)

✓ OK

11. B. J. Mincher, G. Modolo and S. P. Mezyk, *Solvent Extr. Ion Exch.*, **27**, 579 (2009).  
[CrossRef](https://doi.org/10.1080/07366290903114098) (https://doi.org/10.1080/07366290903114098)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=B.%20J..%20Mincher&author=G.%20Modolo&author=S.%20P..%20Mezyk&journal=Solvent%20Extr.%20Ion%20Exch.&volume=27&pages=579&publication_year=2009) (http://scholar.google.com/scholar\_lookup?&author=B.%20J..%20Mincher&author=G.%20Modolo&author=S.%20P..%20Mezyk&journal=Solvent%20Extr.%20Ion%20Exch.&volume=27&pages=579&publication\_year=2009)
12. E. R. Nazin, G.M. Zachinyaev and G. F. Egorov, *Radiochemistry*, **46**, 54 (2004).  
[CrossRef](https://doi.org/10.1023/B%3ARACH.0000024636.63768.0a) (https://doi.org/10.1023/B%3ARACH.0000024636.63768.0a)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=E.%20R..%20Nazin&author=G.M..%20Zachinyaev&author=G.%20F..%20Egorov&journal=Radiochemistry&volume=46&pages=54&publication_year=2004) (http://scholar.google.com/scholar\_lookup?&author=E.%20R..%20Nazin&author=G.M..%20Zachinyaev&author=G.%20F..%20Egorov&journal=Radiochemistry&volume=46&pages=54&publication\_year=2004)
13. R.A. Sheldon, R.M. Lau, M. J. Sorgedrager and F. van Rantwijk, *Green Chem.*, **4**, 147 (2002).  
[CrossRef](https://doi.org/10.1039/b110008b) (https://doi.org/10.1039/b110008b)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=R.A..%20Sheldon&author=R.M..%20Lau&author=M.%20J..%20Sorgedrager&author=F.%20Rantwijk&journal=Green%20Chem.&volume=4&pages=147&publication_year=2002) (http://scholar.google.com/scholar\_lookup?&author=R.A..%20Sheldon&author=R.M..%20Lau&author=M.%20J..%20Sorgedrager&author=F.%20Rantwijk&journal=Green%20Chem.&volume=4&pages=147&publication\_year=2002)
14. M. Freemantle, *Chem. Eng. News*, **76**, 32 (1998).  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=M..%20Freemantle&journal=Chem.%20Eng.%20News&volume=76&pages=32&publication_year=1998) (http://scholar.google.com/scholar\_lookup?&author=M..%20Freemantle&journal=Chem.%20Eng.%20News&volume=76&pages=32&publication\_year=1998)
15. Y.H. Moon, S. M. Lee, S.H. Ha and Y.-M. Koo, *Korean J. Chem. Eng.*, **23**, 247 (2006).  
[CrossRef](https://doi.org/10.1007/BF02705724) (https://doi.org/10.1007/BF02705724)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=Y.H..%20Moon&author=S.%20M..%20Lee&author=S.H..%20Ha&author=Y.-M..%20Koo&journal=Korean%20J.%20Chem.%20Eng.&volume=23&pages=247&publication_year=2006) (http://scholar.google.com/scholar\_lookup?&author=Y.H..%20Moon&author=S.%20M..%20Lee&author=S.H..%20Ha&author=Y.-M..%20Koo&journal=Korean%20J.%20Chem.%20Eng.&volume=23&pages=247&publication\_year=2006)
16. L. C. Branco, J.G. Crespo and C.A. M. Afonso, *Chem. Eur. J.*, **8**, 3865 (2002).  
[CrossRef](https://doi.org/10.1002/1521-3765(20020902)8%3A17<3865%3A%3AAID-CHEM3865>3.0.CO%3B2-L) (https://doi.org/10.1002/1521-3765(20020902)8%3A17<3865%3A%3AAID-CHEM3865>3.0.CO%3B2-L)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=L.%20C..%20Branco&author=J.G..%20Crespo&author=C.A.%20M..%20Afonso&journal=Chem.%20Eur.%20J.&volume=8&pages=3865&publication_year=2002) (http://scholar.google.com/scholar\_lookup?&author=L.%20C..%20Branco&author=J.G..%20Crespo&author=C.A.%20M..%20Afonso&journal=Chem.%20Eur.%20J.&volume=8&pages=3865&publication\_year=2002)

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our Privacy Statement. You can manage your preferences in Manage Cookies.

› [Manage Cookies](#)

✓ OK

Google Scholar ([http://scholar.google.com/scholar\\_lookup?&author=F..%20Rantwijk&author=R.A..%20Sheldon&journal=Chem.%20Rev.&volume=107&pages=2757&publication\\_year=2007](http://scholar.google.com/scholar_lookup?&author=F..%20Rantwijk&author=R.A..%20Sheldon&journal=Chem.%20Rev.&volume=107&pages=2757&publication_year=2007))

19. P. Giridhar, K.A. Venkatesan, T.G. Srinivasan and P. R. Vasudeva Rao, *J. Radioanal. Nucl. Chem.*, **265**, 31 (2005).  
CrossRef (<https://doi.org/10.1007/s10967-005-0785-7>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=J.%20Radioanal.%20Nucl.%20Chem.&volume=265&pages=31&publication\\_year=2005](http://scholar.google.com/scholar_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=J.%20Radioanal.%20Nucl.%20Chem.&volume=265&pages=31&publication_year=2005))
20. P. Giridhar, K.A. Venkatesan, T.G. Srinivasan and P. R. Vasudeva Rao, *J. Nucl. Radiochem. Sci.*, **5**, 21 (2004).  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=J.%20Nucl.%20Radiochem.%20Sci.&volume=5&pages=21&publication\\_year=2004](http://scholar.google.com/scholar_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=J.%20Nucl.%20Radiochem.%20Sci.&volume=5&pages=21&publication_year=2004))
21. P. Giridhar, K.A. Venkatesan, S. Subramaniam, T.G. Srinivasan and P. R. Vasudeva Rao, *J. Alloys Comp.*, **448**, 104 (2008).  
CrossRef (<https://doi.org/10.1016/j.jallcom.2007.03.115>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=S..%20Subramaniam&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=J.%20Alloys%20Comp.&volume=448&pages=104&publication\\_year=2008](http://scholar.google.com/scholar_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=S..%20Subramaniam&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=J.%20Alloys%20Comp.&volume=448&pages=104&publication_year=2008))
22. P. Giridhar, K.A. Venkatesan, T.G. Srinivasan and P. R. Vasudeva Rao, *Electrochim. Acta*, **52**, 3006 (2007).  
CrossRef (<https://doi.org/10.1016/j.electacta.2006.09.038>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=Electrochim.%20Acta&volume=52&pages=3006&publication\\_year=2007](http://scholar.google.com/scholar_lookup?&author=P..%20Giridhar&author=K.A..%20Venkatesan&author=T.G..%20Srinivasan&author=P.%20R..%20Vasudeva%20Rao&journal=Electrochim.%20Acta&volume=52&pages=3006&publication_year=2007))
23. A. Ouadi, O. Klimchuk, C. Gaillarda and I. Billard, *Green Chem.*, **9**, 1160 (2007).  
CrossRef (<https://doi.org/10.1039/b703642f>)  
Google Scholar ([http://scholar.google.com/scholar\\_lookup?&author=A..%20Ouadi&author=O..%20Klimchuk&author=C..%20Gaillarda&author=I..%20Billard&journal=Green%20Chem.&volume=9&pages=1160&publication\\_year=2007](http://scholar.google.com/scholar_lookup?&author=A..%20Ouadi&author=O..%20Klimchuk&author=C..%20Gaillarda&author=I..%20Billard&journal=Green%20Chem.&volume=9&pages=1160&publication_year=2007))
24. M. L. Dietz and D.C. Stepinski, *Talanta.*, **75**, 598 (2008).

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our Privacy Statement. You can manage your preferences in Manage Cookies.

➤ Manage Cookies

✓ OK

[CrossRef](https://doi.org/10.1039/a809672d) (https://doi.org/10.1039/a809672d)

[Google Scholar](http://scholar.google.com/scholar_lookup?) (http://scholar.google.com/scholar\_lookup?

&author=S..%20Dai&author=Y.%20H..%20Ju&author=C.%20E..%20Barnes&journal=J.%20Chem.%20Soc.%2C%20Dalton%20Trans.&volume=8&pages=1201&publication\_year=1999)

27. A. E. Visser, R. P. Swatloski, W.M. Reichert, S. T. Griffin and R. D. Rogers, *Ind. Eng. Chem. Res.*, **39**, 3596 (2000).

[CrossRef](https://doi.org/10.1021/ie000426m) (https://doi.org/10.1021/ie000426m)

[Google Scholar](http://scholar.google.com/scholar_lookup?) (http://scholar.google.com/scholar\_lookup?

&author=A.%20E..%20Visser&author=R.%20P..%20Swatloski&author=W.M.%20Reichert&author=S.%20T..%20Griffin&author=R.%20D..%20Rogers&journal=Ind.%20Eng.%20Chem.%20Res.&volume=39&pages=3596&publication\_year=2000)

28. M. L. Dietz, J.A. Dzielawa, I. Laszak, B.A. Young and M. P. Jensen, *Green Chem.*, **5**, 682 (2003).

[CrossRef](https://doi.org/10.1039/b310507p) (https://doi.org/10.1039/b310507p)

[Google Scholar](http://scholar.google.com/scholar_lookup?) (http://scholar.google.com/scholar\_lookup?

&author=M.%20L..%20Dietz&author=J.A.%20Dzielawa&author=I.%20Laszak&author=B.A.%20Young&author=M.%20P..%20Jensen&journal=Green%20Chem.&volume=5&pages=682&publication\_year=2003)

29. H. Luo, S. Dai, P.V. Bonnesen, A. C. Buchanan III, J.D. Holbrey, N. J. Bridges and R. D. Rogers, *Anal. Chem.*, **76**, 3078 (2004).

[CrossRef](https://doi.org/10.1021/ac049949k) (https://doi.org/10.1021/ac049949k)

[Google Scholar](http://scholar.google.com/scholar_lookup?) (http://scholar.google.com/scholar\_lookup?

&author=H..%20Luo&author=S..%20Dai&author=P.V.%20Bonnesen&author=A.%20C..%20Buchanan&author=J.D..%20Holbrey&author=N.%20J..%20Bridges&author=R.%20D..%20Rogers&journal=Anal.%20Chem.&volume=76&pages=3078&publication\_year=2004)

30. H. Luo, S. Dai and P.V. Bonnesen, *Anal. Chem.*, **76**, 2773 (2004).

[CrossRef](https://doi.org/10.1021/ac035473d) (https://doi.org/10.1021/ac035473d)

[Google Scholar](http://scholar.google.com/scholar_lookup?) (http://scholar.google.com/scholar\_lookup?

&author=H..%20Luo&author=S..%20Dai&author=P.V.%20Bonnesen&journal=Anal.%20Chem.&volume=76&pages=2773&publication\_year=2004)

31. H. Luo, S. Dai, P.V. Bonnesen and A. C. Buchanan III, *J. Alloys Compd.*, **418**, 195 (2006).

[CrossRef](https://doi.org/10.1016/j.jallcom.2005.10.054) (https://doi.org/10.1016/j.jallcom.2005.10.054)

[Google Scholar](http://scholar.google.com/scholar_lookup?) (http://scholar.google.com/scholar\_lookup?

&author=H..%20Luo&author=S..%20Dai&author=P.V.%20Bonnesen&author=A.

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our Privacy Statement. You can manage your preferences in Manage Cookies.

› [Manage Cookies](#)

✓ OK

- [Google Scholar](http://scholar.google.com/scholar_lookup?&author=Z..%20Kolarik&author=U..%20M%C3%BCllich&author=F..%20Gassner&journal=Solvent%20Extr.%20Ion%20Exch.&volume=17&pages=23&publication_year=1999) ([http://scholar.google.com/scholar\\_lookup?&author=Z..%20Kolarik&author=U..%20M%C3%BCllich&author=F..%20Gassner&journal=Solvent%20Extr.%20Ion%20Exch.&volume=17&pages=23&publication\\_year=1999](http://scholar.google.com/scholar_lookup?&author=Z..%20Kolarik&author=U..%20M%C3%BCllich&author=F..%20Gassner&journal=Solvent%20Extr.%20Ion%20Exch.&volume=17&pages=23&publication_year=1999))
34. G. Modolo and R. Odoj, *Solvent Extr. Ion Exch.*, **17**, 33 (1999).  
[CrossRef](https://doi.org/10.1080/07360299908934599) (<https://doi.org/10.1080/07360299908934599>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=G..%20Modolo&author=R..%20Odoj&journal=Solvent%20Extr.%20Ion%20Exch.&volume=17&pages=33&publication_year=1999) ([http://scholar.google.com/scholar\\_lookup?&author=G..%20Modolo&author=R..%20Odoj&journal=Solvent%20Extr.%20Ion%20Exch.&volume=17&pages=33&publication\\_year=1999](http://scholar.google.com/scholar_lookup?&author=G..%20Modolo&author=R..%20Odoj&journal=Solvent%20Extr.%20Ion%20Exch.&volume=17&pages=33&publication_year=1999))
  35. A. E. Visser and R. D. Rogers, *J. Solid State Chem.*, **171**, 109 (2003).  
[CrossRef](https://doi.org/10.1016/S0022-4596(02)00193-7) ([https://doi.org/10.1016/S0022-4596\(02\)00193-7](https://doi.org/10.1016/S0022-4596(02)00193-7))  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=A..%20E..%20Visser&author=R..%20D..%20Rogers&journal=J..%20Solid%20State%20Chem.&volume=171&pages=109&publication_year=2003) ([http://scholar.google.com/scholar\\_lookup?&author=A..%20E..%20Visser&author=R..%20D..%20Rogers&journal=J..%20Solid%20State%20Chem.&volume=171&pages=109&publication\\_year=2003](http://scholar.google.com/scholar_lookup?&author=A..%20E..%20Visser&author=R..%20D..%20Rogers&journal=J..%20Solid%20State%20Chem.&volume=171&pages=109&publication_year=2003))
  36. Y. Zuo, Y. Liu, J. Chen and D. Q. Li, *Ind. Eng. Chem. Res.*, **47**, 2349 (2008).  
[CrossRef](https://doi.org/10.1021/ie071486w) (<https://doi.org/10.1021/ie071486w>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=Y..%20Zuo&author=Y..%20Liu&author=J..%20Chen&author=D..%20Q..%20Li&journal=Ind.%20Eng.%20Chem.%20Res.&volume=47&pages=2349&publication_year=2008) ([http://scholar.google.com/scholar\\_lookup?&author=Y..%20Zuo&author=Y..%20Liu&author=J..%20Chen&author=D..%20Q..%20Li&journal=Ind.%20Eng.%20Chem.%20Res.&volume=47&pages=2349&publication\\_year=2008](http://scholar.google.com/scholar_lookup?&author=Y..%20Zuo&author=Y..%20Liu&author=J..%20Chen&author=D..%20Q..%20Li&journal=Ind.%20Eng.%20Chem.%20Res.&volume=47&pages=2349&publication_year=2008))
  37. F. Kubota, Y. Koyanagi, K. Nakashima, K. Shimojo, N. Kamiya and M. Goto, *Solvent Extr. Res. Dev. Jpn.*, **15**, 81 (2008).  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=F..%20Kubota&author=Y..%20Koyanagi&author=K..%20Nakashima&author=K..%20Shimojo&author=N..%20Kamiya&author=M..%20Goto&journal=Solvent%20Extr.%20Res.%20Dev.%20Jpn.&volume=15&pages=81&publication_year=2008) ([http://scholar.google.com/scholar\\_lookup?&author=F..%20Kubota&author=Y..%20Koyanagi&author=K..%20Nakashima&author=K..%20Shimojo&author=N..%20Kamiya&author=M..%20Goto&journal=Solvent%20Extr.%20Res.%20Dev.%20Jpn.&volume=15&pages=81&publication\\_year=2008](http://scholar.google.com/scholar_lookup?&author=F..%20Kubota&author=Y..%20Koyanagi&author=K..%20Nakashima&author=K..%20Shimojo&author=N..%20Kamiya&author=M..%20Goto&journal=Solvent%20Extr.%20Res.%20Dev.%20Jpn.&volume=15&pages=81&publication_year=2008))
  38. K. Shimojo, K. Kurahashi and H. Naganawa, *Dalton Trans.*, **37**, 5083 (2008).  
[CrossRef](https://doi.org/10.1039/b810277p) (<https://doi.org/10.1039/b810277p>)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=K..%20Shimojo&author=K..%20Kurahashi&author=H..%20Naganawa&journal=Dalton%20Trans.&volume=37&pages=5083&publication_year=2008) ([http://scholar.google.com/scholar\\_lookup?&author=K..%20Shimojo&author=K..%20Kurahashi&author=H..%20Naganawa&journal=Dalton%20Trans.&volume=37&pages=5083&publication\\_year=2008](http://scholar.google.com/scholar_lookup?&author=K..%20Shimojo&author=K..%20Kurahashi&author=H..%20Naganawa&journal=Dalton%20Trans.&volume=37&pages=5083&publication_year=2008))
  39. J. P. Schoebrechts, B. P. Gilbert and G. Duyckaerts, *J. Electroanal Chem.*, **145**, 127 (1983).  
[CrossRef](https://doi.org/10.1016/S0022-0728(83)80298-8) ([https://doi.org/10.1016/S0022-0728\(83\)80298-8](https://doi.org/10.1016/S0022-0728(83)80298-8))  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=J..%20P..%20Schoebrechts&author=B..%20P..%20Gilbert&author=G..%20Duyckaerts&journal=J..%20Electroanal%20Chem.&volume=145&pages=127&publication_year=1983) ([http://scholar.google.com/scholar\\_lookup?&author=J..%20P..%20Schoebrechts&author=B..%20P..%20Gilbert&author=G..%20Duyckaerts&journal=J..%20Electroanal%20Chem.&volume=145&pages=127&publication\\_year=1983](http://scholar.google.com/scholar_lookup?&author=J..%20P..%20Schoebrechts&author=B..%20P..%20Gilbert&author=G..%20Duyckaerts&journal=J..%20Electroanal%20Chem.&volume=145&pages=127&publication_year=1983))

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our [Privacy Statement](#). You can manage your preferences in [Manage Cookies](#).

› [Manage Cookies](#)

✓ OK



41. R.D. Waele, L. Heerman and W.D. Olieslager, *J. Electroanal Chem.*, **142**, 137 (1982).  
[CrossRef](https://doi.org/10.1016/0368-1874(82)80010-5) (https://doi.org/10.1016/0368-1874(82)80010-5)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=R.D..%20Waele&author=L..%20Heerman&author=W.D..%20Olieslager&journal=J.%20Electroanal%20Chem.&volume=142&pages=137&publication_year=1982) (http://scholar.google.com/scholar\_lookup?&author=R.D..%20Waele&author=L..%20Heerman&author=W.D..%20Olieslager&journal=J.%20Electroanal%20Chem.&volume=142&pages=137&publication\_year=1982)
42. J. P. Schoebrechts and B. P. Gilbert, *Inorg. Chem.*, **24**, 2105 (1985).  
[CrossRef](https://doi.org/10.1021/ic00207a028) (https://doi.org/10.1021/ic00207a028)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=J.%20P..%20Schoebrechts&author=B.%20P..%20Gilbert&journal=Inorg.%20Chem.&volume=24&pages=2105&publication_year=1985) (http://scholar.google.com/scholar\_lookup?&author=J.%20P..%20Schoebrechts&author=B.%20P..%20Gilbert&journal=Inorg.%20Chem.&volume=24&pages=2105&publication\_year=1985)
43. M. Yamagata, Y. Katayama and T. Miura, *J. Electrochem. Soc.*, **153**, E5 (2006).  
[CrossRef](https://doi.org/10.1149/1.2136088) (https://doi.org/10.1149/1.2136088)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=M..%20Yamagata&author=Y..%20Katayama&author=T..%20Miura&journal=J.%20Electrochem.%20Soc.&volume=153&pages=E5&publication_year=2006) (http://scholar.google.com/scholar\_lookup?&author=M..%20Yamagata&author=Y..%20Katayama&author=T..%20Miura&journal=J.%20Electrochem.%20Soc.&volume=153&pages=E5&publication\_year=2006)
44. W.H. Smith and D.A. Costa, *Radiat. Phys. Chem.*, **60**, 157 (2001).  
[CrossRef](https://doi.org/10.1016/S0969-806X(00)00336-4) (https://doi.org/10.1016/S0969-806X(00)00336-4)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=W.H..%20Smith&author=D.A..%20Costa&journal=Radiat.%20Phys.%20Chem.&volume=60&pages=157&publication_year=2001) (http://scholar.google.com/scholar\_lookup?&author=W.H..%20Smith&author=D.A..%20Costa&journal=Radiat.%20Phys.%20Chem.&volume=60&pages=157&publication\_year=2001)
45. D. Allen, G. Baston, A. E. Bradley, T. Gorman, A. Haile, I. Hamblett, J. E. Hatter, M. J. F. Healey, B. Hodgson, R. Lewin, K.V. L. B. Newton, W. R. Pitner, D.W. Rooney, D. Sanders, K. R. Seddon, H. E. Sims and R. C. Thied, *Green Chem.*, **4**, 152 (2002).  
[CrossRef](https://doi.org/10.1039/b111042j) (https://doi.org/10.1039/b111042j)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=D..%20Allen&author=G..%20Baston&author=A.%20E..%20Bradley&author=T..%20Gorman&author=A..%20Haile&author=I..%20Hamblett&author=J.%20E..%20Hatter&author=M.%20J.%20F..%20Healey&author=B..%20Hodgson&author=R..%20Lewin&author=K.V.%20L.%20B..%20Newton&author=W.%20R..%20Pitner&author=D.W..%20Rooney&author=D..%20Sanders&author=K.%20R..%20Seddon&author=H.%20E..%20Sims&author=R.%20C..%20Thied&journal=Green%20Chem.&volume=4&pages=152&publication_year=2002) (http://scholar.google.com/scholar\_lookup?&author=D..%20Allen&author=G..%20Baston&author=A.%20E..%20Bradley&author=T..%20Gorman&author=A..%20Haile&author=I..%20Hamblett&author=J.%20E..%20Hatter&author=M.%20J.%20F..%20Healey&author=B..%20Hodgson&author=R..%20Lewin&author=K.V.%20L.%20B..%20Newton&author=W.%20R..%20Pitner&author=D.W..%20Rooney&author=D..%20Sanders&author=K.%20R..%20Seddon&author=H.%20E..%20Sims&author=R.%20C..%20Thied&journal=Green%20Chem.&volume=4&pages=152&publication\_year=2002)
46. L. Berthon, S. I. Nikitenko, I. Bisel, C. Berthon, M. Faucon, B. Saucerotte, N. Zorz

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our Privacy Statement. You can manage your preferences in Manage Cookies.

› [Manage Cookies](#)

✓ OK



%2C%20C.%20Berthon%2C%20I.%20Bisel%2C%20S.%20Legand%20and%20Ph.  
%20Moisy%2C%20Dalton%20Trans.%2C%20924%20%282008%29.)

48. M.Y. Qi, G. Z. Wu, S.M. Chen and Y. D. Liu, *Radiat. Res.*, **167**, 508 (2007).  
[CrossRef](https://doi.org/10.1667/RR0727.1) (https://doi.org/10.1667/RR0727.1)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=M.Y..%20Qi&author=G.%20Z..%20Wu&author=S.M..%20Chen&author=Y.%20D..%20Liu&journal=Radiat.%20Res.&volume=167&pages=508&publication_year=2007) (http://scholar.google.com/scholar\_lookup?&author=M.Y..%20Qi&author=G.%20Z..%20Wu&author=S.M..%20Chen&author=Y.%20D..%20Liu&journal=Radiat.%20Res.&volume=167&pages=508&publication\_year=2007)
49. M.Y. Qi, G. Z. Wu, Q.M. Li and Y. S. Luo, *Radiat. Phys. Chem.*, **77**, 877 (2008).  
[CrossRef](https://doi.org/10.1016/j.radphyschem.2007.12.007) (https://doi.org/10.1016/j.radphyschem.2007.12.007)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=M.Y..%20Qi&author=G.%20Z..%20Wu&author=Q.M..%20Li&author=Y.%20S..%20Luo&journal=Radiat.%20Phys.%20Chem.&volume=77&pages=877&publication_year=2008) (http://scholar.google.com/scholar\_lookup?&author=M.Y..%20Qi&author=G.%20Z..%20Wu&author=Q.M..%20Li&author=Y.%20S..%20Luo&journal=Radiat.%20Phys.%20Chem.&volume=77&pages=877&publication\_year=2008)
50. L.Y. Yuan, J. Peng, L. Xu, M. L. Zhai, J.Q. Li and G. S. Wei, *Dalton Trans.*, 6358 (2008).  
[Google Scholar](https://scholar.google.com/scholar?q=L.Y.%20Yuan%2C%20J.%20Peng%2C%20L.%20Xu%2C%20M.%20L.%20Zhai%2C%20J.Q.%20Li%20and%20G.%20S.%20Wei%2C%20Dalton%20Trans.%2C%206358%20%282008%29.)) (https://scholar.google.com/scholar?q=L.Y.%20Yuan%2C%20J.%20Peng%2C%20L.%20Xu%2C%20M.%20L.%20Zhai%2C%20J.Q.%20Li%20and%20G.%20S.%20Wei%2C%20Dalton%20Trans.%2C%206358%20%282008%29.)
51. L.Y. Yuan, J. Peng, L. Xu, M. L. Zhai, J.Q. Li and G. S. Wei, *Radiat. Phys. Chem.*, **78**, 1133 (2009).  
[CrossRef](https://doi.org/10.1016/j.radphyschem.2009.07.003) (https://doi.org/10.1016/j.radphyschem.2009.07.003)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=L.Y..%20Yuan&author=J..%20Peng&author=L.%20Xu&author=M.%20L.%20Zhai&author=J.Q..%20Li&author=G.%20S.%20Wei&journal=Radiat.%20Phys.%20Chem.&volume=78&pages=1133&publication_year=2009) (http://scholar.google.com/scholar\_lookup?&author=L.Y..%20Yuan&author=J..%20Peng&author=L.%20Xu&author=M.%20L.%20Zhai&author=J.Q..%20Li&author=G.%20S.%20Wei&journal=Radiat.%20Phys.%20Chem.&volume=78&pages=1133&publication\_year=2009)
52. P. Tarabek, S.Y. Liu, K. Haygarth and D. M. Bartels, *Radiat. Phys. Chem.*, **78**, 168 (2009).  
[CrossRef](https://doi.org/10.1016/j.radphyschem.2008.11.006) (https://doi.org/10.1016/j.radphyschem.2008.11.006)  
[Google Scholar](http://scholar.google.com/scholar_lookup?&author=P..%20Tarabek&author=S.Y..%20Liu&author=K.%20Haygarth&author=D.%20M..%20Bartels&journal=Radiat.%20Phys.%20Chem.&volume=78&pages=168&publication_year=2009) (http://scholar.google.com/scholar\_lookup?&author=P..%20Tarabek&author=S.Y..%20Liu&author=K.%20Haygarth&author=D.%20M..%20Bartels&journal=Radiat.%20Phys.%20Chem.&volume=78&pages=168&publication\_year=2009)

## Copyright information

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our Privacy Statement. You can manage your preferences in Manage Cookies.

› [Manage Cookies](#)

✓ OK

- Accepted 13 August 2010
- First Online 02 September 2010
- DOI <https://doi.org/10.1007/s11814-010-0386-1>
- Publisher Name Springer US
- Print ISSN 0256-1115
- Online ISSN 1975-7220
- [About this journal](#)
- [Reprints and Permissions](#)

## Personalised recommendations

1. [A Novel Waste Form for Disposal of Spent-Nuclear-Fuel Reprocessing Waste: A Vitrifiable Cement](#)  
Gougar, Mary Lou Dunzik... Siemer, Darryl D.  
*Nuclear Technology* (2017)
2. [Extraction-spectrophotometric analysis of palladium in the reprocessing waste of spent nuclear fuels using benzo-15-Fu, Lian... Fang, Shengqiang](#)  
*Journal of Radioanalytical and Nuclear Chemistry* (1998)
3. [On the possibility of reprocessing spent nuclear fuel and radioactive waste by plasma methods](#)  
Vorona, N. A.... Khomyakov, Yu. S.  
*Physics of Atomic Nuclei* (2015)

Want recommendations via email? [Sign up now](#)

Powered by  Recommended

## SPRINGER NATURE

We use cookies to personalise content and ads, to provide social media features and to analyse our traffic. We also share information about your use of our site with our social media, advertising and analytics partners in accordance with our [Privacy Statement](#). You can manage your preferences in [Manage Cookies](#).

› [Manage Cookies](#)

✓ OK