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Simplified UK Magnox waste glass alteration layer characterisation using 29Si, 17O and 25Mg NMR techniques

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The magnesium content of UK Magnox waste glass makes its aqueous durability much poorer than glasses such as SON68, which does not contain Mg. The glass dissolution kinetics is ultimately dependent on the composition/structures of the altered layers(1), here we try to elucidate formation mechanisms.

Alteration layers formed by in-situ precipitation have been discussed widely(2,3), but any direct identification of precipitated phases is not yet known. The altered layers of simplified Magnox waste glasses were examined using a variety of 17O, 25Mg and 29Si solid-state NMR techniques. In terms of quantification and species identification, the Mg containing glass incorporates 3-4 times the amount of 17O derived from the 17O enriched leachate compared with a Ca glass, identified as bridging oxygen and hydroxyl oxygen species. At least two types of amorphous surface phases were characterised by proton cross-polarisation (CP) that show local environments similar to clay mineral phases(4). 25Mg and 29Si NMR spectra corroborate the active chemical role of Mg in precipitation and the multiphase nature of the alteration layer.

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2. Geisler, T (2010) Journal of Non-Crystalline Solids 356 pp. 1458-1465
3. Hellmann, R (2015) Nature Materials 14 pp. 307-311
4. Thien, B. et al. (2010) Applied Clay Science 49 pp. 135-141

Summary

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