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Vitrification as a key solution for nuclear waste immobilisation

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Vitreous materials in form of both relatively homogeneous glasses and glass crystalline materials (GCM) incorporating crystalline disperse phases are currently the most reliable wasteforms effectively used on industrial scale for nuclear waste immobilisation. Glasses are solid state materials with a topologically disordered atomic structure which can be considered as true solid solutions i.e., solutions being frozen via vitrification to a solid state without phase separation. Nuclear waste vitrification is attractive because of technological and compositional flexibility enabling hazardous elements to be safely immobilised providing a glassy material characterised by high corrosion resistance, mechanical and radiation durability, as well as effectively reducing the volume of the resulting wasteform. Borosilicate and to a lesser extent phosphate glasses are the overwhelming world-wide choice for the immobilization of high-level radioactive wastes (HLW) resulting from used nuclear fuel reprocessing and low- and intermediate level radioactive wastes (LILW) such as those from operation of nuclear power plants and legacy waste. Vitrification is a mature technology which has been used on an industrial scale for more than fifty years. Continued advances in devising durable vitreous wasteforms and improving nuclear waste vitrification technologies provides key solutions in enabling widespread deployment of nuclear energy.

Speaker Bio

Primary author: OJOVAN, Michael (Imperial College London)

Presenter: OJOVAN, Michael (Imperial College London)

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