

# How Fundamentals of Phase Equilibria and Diffusion Contribute to the RERTR program



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One of the oldest programs of the U.S. Department of Energy is the Reduced Enrichment for Research and Test Reactors (RERTR) program. This program develops technology necessary to convert both research and test reactors, including some medical purpose reactors, from using high enriched uranium (HEU) to using low enriched uranium (LEU) fuels and targets. This conversion is related to non-proliferation by making weapons grade nuclear material less available. In order to pursue their goal, the RERTR Program, managed by the Office of Nuclear Material Threat Reduction in the National Nuclear Security Administration, has held annual international conferences since its inception in 1978.

The RERTR program is currently emphasizing basic investigations to support the development of practical applications. For example, one such program requires a basic investigation of phase equilibria and diffusion. The objective is to develop two types of low enriched metallic uranium fuel: one is a dispersion fuel based on U-Mo pellets dispersed in an Al matrix and the other is a monolithic fuel where a U-10Mo foil is encased in Al-6061 cladding. In both cases a diffusion barrier is needed to limit interdiffusion between the fuel and Al or Al alloy. A systematic investigation of multicomponent phase diagrams and interdiffusion is under way to determine the optimum diffusion barrier and to develop the necessary heat treatments and thermo-mechanical processing to make the fuel. The studies will include tests involving irradiation to make them apply to reactor operation.

The RERTR program has pursued a methodical approach for technical achievements by using basic knowledge of multicomponent phase equilibria and diffusion. In this way it is playing a critical role in the successful qualification and application of new low-enriched uranium fuels for use in research and test reactors around the world.



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