

Developmental activities related to thorium purification and metal production

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Thorium based alloys are potential metallic fuel for breeder as well as high temperature reactors. Th-U alloys are of particular interest as uranium is required to be combined with thorium for the later to be used as nuclear fuel. Th-U fuel cycle offers many advantages e.g. possible use in thermal as well as fast reactors, inherent proliferation resistance, high temperature of operation etc. Thorium based metallic fuels offer certain advantages e.g. high thermal conductivity, ease of fabrication etc. over thoria which is being used in commercial reactors. The work of Th-U system has been undertaken keeping two primary objectives in view viz. (i) establishing its microstructural features and to note the variations in those, if any, brought by processing e.g. rolling, heat treatment etc. and (ii) to assess, few thermal properties relevant to fuel application.

Efforts have been directed at making Th-U as well as few ternary compositions viz. Th-U-Zr alloys by arc melting in inert atmosphere. The basic processing and characterization set-up have been developed. Metallographic practices for the various thorium alloys also have been standardized. Microstructural features of Th-U alloys have been established.

A new process for selective recovery of thorium and uranium from thorium cake of monazite origin has been developed, where the thorium cake was dissolved in nitric acid and separation of U(VI) was carried out using tris -2 ethyl hexyl phosphate (TEHP) diluted with *n*-paraffin. The recovery of Th(IV) from raffinate solution containing large amount of rare earths was carried out using 1M TiAP/*n*-paraffin as solvent. Finally, thorium from organic phase was stripped using 0.05 M HNO₃ and precipitated as thorium oxalate. Based on experimental results, a process flow-sheet has been proposed for selective recovery of uranium and thorium from monazite.

For pure Th-metal, lab scale process has already been developed at UED and recently using this metal NFG has produced 99% pure thorium foils for Physical Research Laboratory, Ahmedabad as per their request.

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