Public Abstract

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Title:AN INVESTIGATIVE STUDY ON NEUTRON EMISSIONS FROM TITANIUM-DEUTERIUM SYSTEM UNDER THERMAL SHOCK

The purpose of this study is to investigate the titanium-deuterium system under thermal shock, as a potential neutron source. The expected neutron emission is unique, i.e. it is monoenergetic with energy of 2.45 MeV, which is valuable for calibrating neutron detectors. In our study, titanium was loaded with deuterium gas at room temperature in an experimental system, and the system was subjected to rapid thermal cycling by repeated cooling with liquid nitrogen, followed by rapid warm up phases to create a non–equilibrium condition in titanium lattice. Neutron bursts were monitored using a 3He detector, which responds to slow neutrons, a moderated 3He detector, which responds to slow and fast neutrons, and a proton recoil detector, which responds to fast neutrons. The pressure and temperature of the system was monitored throughout the experiments. The result of this work shows that: 1) loading of titanium with deuterium gas should be done under high vacuum conditions (<0.001 mtorr) to remove environmental contaminants, which was found to inhibit the titanium-deuterium reaction, 2) cracks observed in titanium samples from lattice stress varied in size and location in titanium lattice and dependent on the level of deuterium loading. The presence of cracks in some locations indicates that the titanium-deuterium reaction is a local effect, 3) low level neutron burst were observed in less than 23% of all experiments and involved the detection of a single neutron burst, suggesting that neutron emission is a statistical process occurring at low probability. The neutron burst was observed from partially deuterated titanium samples. The level of neutrons detected is consistent with what has been reported in literature. 4). A large temperature increased from room temperature to 450 0C during phase transition from ?-titanium to ?-titanium occurred, but no neutrons were observed. The temperature increased is likely associated with the exothermic reaction that occurs during hydride formation, which does not lead to neutron emission. 5) No evidence of tritium or nuclear transmutation was observed in our experimental system.