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RESEARCH AND DEVELOPMENT ON HTGR FUELS AND MATERIALS UTILISING WWR-K RESEARCH REACTOR

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Japan Atomic Energy Agency (JAEA) and the Institute of Nuclear Physics (INP) have been being developing the High Temperature Gas-cooled Reactor (HTGR) fuels and materials by using WWR-K reactor within the framework of International Science and Technology Center (ISTC) since 2010 and so far.

The High Temperature Engineering Test Reactor (HTTR) constructed and being operated in Oarai JAEA is known as a Japanese research HTGR, of which the reactor core is fueled with so-called "pin-in-block"typed prismatic elements and performs at 950 ℃ of the maximum outlet coolant temperature at 30 MW in thermal power.

To upgrade fuels and materials technologies of Japanese HTTR to those of practical HTGRs, such as small modular reactor (SMR) and Very High Temperature Reactor (VHTR) proposed by Generation IV International Forum to be developed worldwide, the INP in collaboration with JAEA has conducted three regular projects and one partner project which are coordinated by ISTC.

K-1797 regular project was performed from 2010 to 2015 for an irradiation test for high burn-up HTGR fuel. We confirmed the high burn-up of 94GWd/t and the integrity by observing the Kr-88 release rate. The release rate corresponded between the surface contamination by uranium in the fabrication and the initial failure of two particles. Then, we concluded there is no failure during the irradiation experiments.

K-2222 regular project was performed from 2017 to 2019 for a Post Irradiation Experiment (PIE) for high burn-up HTGR fuel. As a result, the design curve of thermal conductivity was extended, and feasibility of new matrix material made by mixing natural graphite and artifical graphite was confirmed.

KZ-2514 regular project was performed from 2020 to 2023 for R&D on SiC matrix HTGR fuel. The samples of SiC were selected for the matrix of a compact fuel (SiC matrix). Two types of samples were studied: pure SiC samples and SiC samples with TRISO fuel particle simulators. In the simulators, the fuel is replaced by SiC, which is coated with two layers of high-density pyrocarbon (PyC), between which there is a coating of SiC. The SiC samples were irradiated in an inert gas atmosphere in the WWR-K reactor. Post-irradiation examinations were carried out on compressive strength, hardness, Young's modulus, swelling/shrinkage, and coefficient of thermal linear expansion. In the present report, the outline is discribed.

K-2080p partner project was performed from 2013 to 2017 for R&D on oxidation resistance graphite. The oxidation resistance graphite is made by covering the surface with SiC layer. The integrity under the irradiation condition was confrimed by observing the surface of the samples.

Moreover, future subjects which JAEA is plannning to develope will be explained.

Section

Energy and materials science (Section 2)

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