MICROSTRUCTURE AND MECHANICAL PROPERTIES RESPONSE OF ODS ALLOYS UNDER SWIFT HEAVY ION IRRADIATION*

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Radiation tolerance of the perspective constructive materials for Generation IV nuclear reactors is one of the main research activities over the past years [1-3]. Special interest is dedicated to studies of the swift heavy ion (SHI) irradiation influence on the structure stability of fuel cladding materials that supposed to be in direct contact with fission fragments in reactor core. According to the previous research SHI irradiation is the only type of irradiation that can lead to significant changes in microstructure in dielectric materials down to complete amorphization [4-6].

In the present work ferritic ODS alloys reinforced by different nanosized particles based on yttrium oxides ($Y_2Ti_2O_7$, Y_2TiO_5, $Y_4Al_2O_9$) and carbides as well as nanopowders of the same composition as embedded nanoparticles were exposed to 1-3 MeV/amu Xe, Kr and Bi irradiation with different fluences. Post-irradiation microstructure examinations were made using transmission electron microscopy and X-ray diffraction. It was shown that SHI irradiation doesn't have crucial effect on metallic matrix and at the same time it leads to latent track formation of several nanometers in oxides and carbides. Starting from $2\cdot10^{12}$ cm^{-2} fluence, track overlapping takes place and with fluence increasing the phase transformation into amorphous state of the whole dielectric particles occurs. Mechanical properties of irradiated ODS alloys with crystalline, partially amorphous and completely amorphous particles were studied by nanoindentation and in-situ micropillar compression tests. Additional examinations were made on irradiated ferritic alloy without particles in order to estimate the possible influence on mechanical properties by irradiated ferritic matrix.

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