Interface properties of selected U-based thin films studied by Rutherford Backscattering Spectroscopy

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We have investigated and tailored thin films of uranium nitride (UN) and uranium-iron (UFe_x) using ion beam analysis (IBA) techniques and ion beam modification of materials (IBMM).

Uranium nitride (UN) with its high melting point, density, and thermal conductivity belongs to those actinide nitrides that have an important application potential as advanced fuels and targets for fast reactors. The stability and interactions with environment of this type of material on atomic scale are still to be studied. We have investigated the concentration depth profiles and ion irradiation effect on UN thin films deposited on quartz glass (at various temperatures of -200^{o}C, +25^{o}C and +300^{o}C) by Rutherford Backscattering Spectroscopy (RBS) using 2 MeV He^+ ions. A perfect stoichiometry with a layer thickness of 660 nm was found for the as-deposited film at -200^{o}C. An increase of the deposition temperature led to an enhancement of surface oxidization and an increase of the thickness of the mixed U-N-Si-O layers at the interface. 1MeV Ar^+ ion beam irradiation with ion fluences of $1.2x10^{16}$ ions/cm^2 caused a large change in the layer composition and a large increase of the total film thickness for the film deposited at -200^{o}C and at +25^{o}C. Such an ion fluence caused almost no change for the total film thickness for the film deposited at +300^{o}C. An enhanced mixing effect for this film was obtained upon a consecutive irradiation with ion fluence of $2.3x10^{16}$ ions/cm^2.

UFe_2 is one of rare examples of combination of 3*d* and 5*f* magnetism in a compound with relatively high T_C (162 K). We have studied the UFe_{2+x} films deposited onto Si or fused silica substrates. Films with a typical thickness of 400 nm were characterized by in-situ XPS, EPMA, RBS, and glancing angle XRD. Except for a thin oxidized layer, the films are stable in air. The deposited films on both types of substrates are amorphous, with some USi3 or U oxides at the interface.