The Oxidation Rate of Thin Films of Uranium and Uranium Nitride as Measured by the use of Ellipsometry

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Uranium is a candidate high Z material for multilayer reflectors for the soft x- ray regime. It suffers the disadvantage of being low melting and chemically active. However, since over certain wavelength ranges it is considerably more transparent than many other high Z materials our group has looked at using it in multilayer stacks. One area of current interest is for reflectors at 41 eV. We realized that we needed to understand the kinetics of the oxidation of uranium and some of its compounds since oxidation could be particularly important for the vacuum UV where oxygen is highly absorbing. Uranium is known to oxidize at elevated temperatures and moist air. The rate at which it oxidizes near room temperature and in forming ultra thin films is not known. Therefore we undertook an ellipsometric study of the oxidation rate of DC magnetron sputtered uranium and uranium nitride thin films. Ellipsometry is well suited for this study since the oxides formed were expected to be sufficiently transparent in the visible range to measure the growth of oxide many hundreds of angstroms thick. We determined that the oxidation rate of uranium nitride is substantially smaller than that of uranium by the use of single wavelength and spectroscopic ellipsometry. Auger analysis confirms the presence of uranium oxide on the surface. Stoichiometry is approximately 1:6 uranium to oxygen. We also investigated the utility of ellipsometry in the determining of the uniformity of aluminum for multilayer films.