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Reaction of Urnium Dioxide with CF_4/O_2 r. f. Plasma

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Abstract

Research on the etching reaction of UO_2 in CF_4/O_2 r. f. plasma is carried out at temperatures of up to 370℃ under the total pressure of 0.3 Torr. The reaction rates are investigated as functions of CF_4/O_2 ratio, plasma power, and substrate temperature. It is found that the highest etching rate is obtained at 20%O_2 mole fraction regardless of r. f. power and substrate temperature. The highest etching reaction rate at 370℃ under 150W exceeds 1000monolayers/min., which is equivalent to 0.4 μm/min. The mass spectrometry analysis result reveals that the major reaction product is uranium hexa-fluoride UF_6. Based on the experimental findings, dominant overall reaction of uranium dioxide in CF_4/O_2 plasma is determined:

$$8UO_2 + 12CF_4 + 3O_2 = 8UF_6 + 12CO_{2-x}$$

where CO_{2-x} represents the undetermined mix of CO_2 and CO.