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Mechanical and Thermal Properties of (U,Pu)O2-x

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Designing nuclear fuels and simulating their irradiation behaviors in a reactor require modeling and formulation of a variety of fundamental properties. The property study of uranium-plutonium mixed oxide (MOX) as fast reactor fuels still requires further investigation because of the diverse parameters and the technical obstacles of plutonium operation.
Young's modulus of MOX pellets was evaluated by measuring the sound velocities of longitudinal and transverse waves in the pellets as functions of porosity, oxygen-to-metal ratio (O/M) and plutonium content. The effect of each was fitted to give a single equation, which is important in designing nuclear fuels and simulating their irradiation behaviors in a reactor. The results showed that porosity was the most important factor that 20% of the porosity decreased Young's modulus by neatly 100GPa while O/M and plutonium content could change the Young's modulus by ˜20GPa.
From the measured sound velocities, temperature dependence on Young's modulus and specific heat capacity were calculated on the Debye model by leveraging the thermal expansion data. The temperature dependence that Young's modulus decreases with increasing temperature is in good agreement with literature data. The specific heat capacity also agrees with that of calculated value by Kopp's method, taken the Schottky term and the excited term into account. The relationship between mechanical and thermal properties was well described.

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