Mechanical loss reduction at low temperature after crystallization in a titania-tantala film

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Abstract Due to its excellent optical properties, such as low absorption and scattering, amorphous Ta2O5 is commonly used as an optical coating material, often in combination with SiO2 layers to produce a highly reflective stack. However, the high mechanical loss of

Ta2O5 limits the thermal-noise performance of such coatings when used in precision measurement applications. Doping with TiO2 has previously been shown to slightly reduce the mechanical loss, but it is still very high compared to many other materials, particularly at low temperatures. In this paper, we present a detailed study of different heat treatment temperatures and of Ti concentrations of up to nominally 75%. We show a significant mechanical-loss reduction for the mixture with the highest Ti cation content, which crystallized after heat treatment at 500 degrees C. The resulting loss is much lower than that of pure TiO2 or that of Ta2O5 after crystallization, making further studies highly interesting, in particular investigations of scattering which may pose a major drawback for optical applications.

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