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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°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. © 2025 authors. Published by the American Physical Society.

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