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Crystallization activation energy in mirror coatings

A major limiting factor in improving sensitivity of Gravitational Wave (GW) detectors is thermal noise in the amorphous mirror coatings of interferometric gravitational-wave detectors. This is especially true for the crucial frequency range around 100 Hz in room-temperature detectors. Mirror coatings are deposited by Ion-Beam Sputtering and designed as thickness-optimized Bragg's reflectors, alternating between high- and low- refractive index layers. Post-deposition annealing allows to reduce internal strains and improve optical quality. The current standard treatment, 10 hours thermal annealing at 500℃ in air, was determined by a trial-and-error approach. However, this annealing procedure could in principle be further optimized in order to achieve better performances by coating materials.
In this work, we report on a study currently underway to determine the activation energy of crystallization in high-refractive index coating materials, as a function of annealing temperature and time. Knowledge of the parameters which trigger a phase transition from amorphous to poly-crystalline coatings will allow us to optimize the annealing treatment and to create a protocol appropriate for each coating material.

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