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The Virgo Coating Collaboration: a new deposition facility and preliminary results on nano-layered coatings

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Thermal noise in the coatings of the test masses of the ground-based interferometric detectors of gravitational waves is the dominant noise contribution in the most sensitive frequency band, where the first gravitational signals have been detected and where several cosmic sources are deemed to exist. Hence developing coatings with reduced thermal noise is among the primary tasks of the Virgo and LIGO experiments. Several strategies have been proposed and/or implemented so far in order to reduce coating thermal noise, e.g. using amorphous co-sputtered or nanolayered mixtures of two different materials as high-index constituent, optimizing layers'thickness (non-QWL multilayers), using crystalline coatings, etc. Multilayers, where the high and/or low index material are nanometer-scale stratified glassy oxides mixtures - consisting of stacked layers of two (or more) different materials with sub-wavelength thickness - behave macroscopically as homogeneous films, whose properties are amenable to simple modeling, which makes them easily engineerable. Furthermore, composites made of alternating layers of an optically dense material, like Titania, Hafnia or Zirconia, and a good glass-former, like Silica or Alumina, are stable against crystallization in the post-deposition annealing treatment and cryo-friendly. Special focus is given to the deposition facility recently installed at University of Sannio based on plasma-assisted e-beam evaporator, and to the first deposited samples. The current and planned work of the Virgo Coating Collaboration groups on nm-layered composite deposition and characterization is presented.

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