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Development of ultra-low optical and mechanical loss aSi coatings using novel ECR ion beam deposition

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Brownian thermal noise associated with the multilayer mirror coatings continues to limit the sensitivity of GW detectors within their most sensitive frequency band. Currently these coatings are fabricated using ion beam deposition (IBD), delivering sub-ppm-level optical absorption and ppm-level scatter. However, further reductions in mechanical dissipation will be essential to fully exploit planned upgrades to Advanced LIGO, e.g. squeezing. Researchers at UWS and UoG have developed a new generation of IBD. The ion source uses electron cyclotron resonance (ECR) within a λ/4 microwave (2.4GHz) cavity to produce an ultra-clean (filament-free) plasma and incorporates a gridless extraction supplying ion energies up to 15keV. Initial results of aSi films show optical absorption of 20ppm at 1550nm for a λ/4 stack (tenfold reduction) with an upper limit on the mechanical loss of 1.2e-4 (factor of 2 reduction over Ta2O5). Details of heated substrate deposition (up to 500C) are also presented.

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