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A multipurpose UHV manipulator for surface studies

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Abstract. A large substrate manipulator allowing temperature variation between 80 and 870 K while providing 2D translation and tilt capabilities is outlined.

Studies of thin-film nucleation and growth have reported considerable structural variations with substrate temperature—particularly density [1] and adhesion [2] changes resulting from the temperature dependence of particle accommodation, 'sticking' and surface mobility [3, 4].

Optimisation of multilayer optics for the high-energy SXR range (700–1200 eV) suffers from severe reflectivity degradation due to interfacial roughness, contributed primarily by the material film structure and interfacial diffusion.

A practical means of investigating the reflectivity–temperature dependence, as well as fully characterising the variation in heavy-atom thin-film nucleation, was required.

A review of instruments commercially available (VG Instruments, Hastings) and reported in the literature [5–9] revealed operational inadequacies and limitation in substrate dimensions. A non-dedicated custom built assembly was designed for a maximum substrate volume of $70 \times 50 \times 4\ mm^3$ (see figure 1).

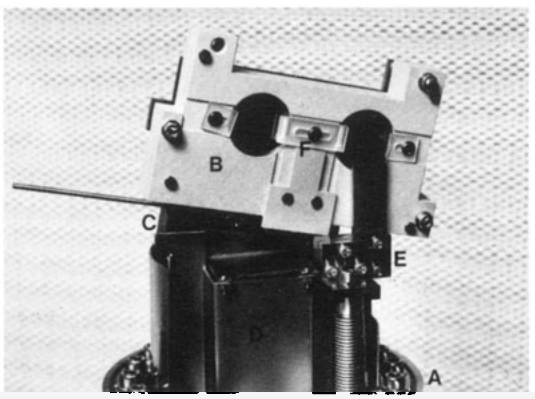

Figure 1. The apparatus. Key: A: cylindrical mount (200 mm OD flange); B: ceramic encasement heater; C: translation/tilt assembly; D: shielding (radiation/evaporant); E: micrometre shutter; F: platinum RID mount.

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The arrangement was based around a thermally isolated ceramic encasement heater assembly independently mounted to allow *yz* and tilt translation—the ceramic holder was flexibly designed to allow simple modification depending on the substrate dimensions. A cryogenic attachment via copper braid was utilised with the liquid nitrogen feed employing the advantages of both continuous flow and reservoir cryostat systems [10]. Temperature sensing was implemented using high-accuracy miniature platinum RTDs embedded within the heater and also surface mounted. A micrometre shutter, electron microscopy specimen holder and full automated control were also developed.

An overall compact design resulted from the desire to utilise the minimum operational volume—a separate cylindrical mount (200 mm OD flange) was produced to position the instrument flange within the deposition chamber.

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