Absorption calibration of coatings with a proxy pump

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100-word summary

Multilayer coatings may not respond as simple thin films when tested with a photothermal technology. Moving to longer wavelengths, where the layers are thicker, requires individual calibration of every coating. We report on the successful introduction of a green “proxy pump” technique for the characterization of high reflectivity GaAs/AlGaAs crystalline coatings with center wavelengths from 1064 nm to 3800 nm. The penetration depth, being a fraction of a micron for GaAs at 532 nm, means that the proxy pump generates the same thermal field in the coating and substrate as the infrared pump with the benefit of known absorbed power.

Abstract

Multilayer coatings may not respond as simple thin films, both optically and thermally, when tested with a photothermal technology. At infrared (IR) wavelengths and especially in the mid-IR, where thicknesses of layers are larger, individual calibration of every coating design is essential. We report on a new experimental approach, the “proxy pump” calibration technique, which is applied quickly and in situ for the efficient characterization of the photothermal response of high reflectivity (HR) GaAs/AlGaAs multilayers. For this work, the photothermal setup is equipped then with an additional, “proxy” pump having the same beam spot size as the main pump. The other requirement for this additional pump is known absorption in the coating.

The technique was implemented with a low power 532 nm pump for the HR GaAs/AlGaAs crystalline coatings with design wavelengths ranging from 1064 nm to 3800 nm. As the penetration depth is a fraction of a micron for GaAs at 532 nm, the proxy pump generates same thermal field in the coating and the substrate as the main IR pump, with the benefit of known absorbed power. Two different low-noise optical probes were used, including a red HeNe-laser and a 1310 nm single-frequency diode. Both green proxy pump and the red probe initially appear to be non-ideal choices because of the potential for free carriers generation in these GaAs-based coatings , giving rise to nonlinear absorption and non-thermal effects with these sources. We will show in detail, however, that the linear thermal effect of absorption in GaAs dominates for the green pump. A very weak non-thermal effect had only been detected for the IR pump and for the red probe, although clearly separable from the thermal signal.

Speaker Bio

Alexei Alexandrovski, General Partner at Stanford Photo-Thermal Solutions (SPTS), obtained his PhD in Physics at Moscow State University in 1977. Until 1997 he worked in various positions in the research staff of the Moscow State in the field of crystal growth and nonlinear optics. From 1997 till 2009 he was a research scientist at the Ginzton Lab, Stanford University, where he introduced Photothermal Common-Path Interferometry for the measurement of low absorption in optical components. The technology was commercialized in the year 2003 with the foundation of SPTS. Dr. Alexandrovski has published more than 100 journal articles and conference proceedings.

keywords: absorption, photothermal spectroscopy, interference coatings, aluminum gallium arsenide, near infrared, mid-infrared