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Measurements of Striae in CR+ Doped YAG Laser Crystals

by

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Striations in Czochralski (CZ) grown crystals have been observed in materials such as GaAS, silicon, photorefractive crystals used for data storage, potassium titanyl phosphate crystals and $LiNbO_3$. Several techniques have been used for investigating these defects including electron microscopy, laser scanning tomography, selective photoetching, X-ray diffuse scattering, interference orthoscopy, laser interferometry and micro-Fourier transform infrared spectroscopy mapping.

A 2mm thick sample of the material to be investigated is illuminated with light that is absorbed and non-absorbed by the ion concentration to be observed. The back surface of the sample is focused onto an solid-state image detector and images of the input beam and absorbed (and diffracted) beams are captured at two wavelengths. The variation of the coeficient of absorption as a function of distance on the sample can be derived from these measurements.

A Big Sky Software Beamcode system is used to capture and display images. Software has been written to convert the Beamcode data files to a format that can be imported into a spreadsheet program such as Quatro Pro. The spreadsheet is then used to manipulate and display data.

A model of the intensity map of the striae collected by the imaging system has been proposed and a data analysis procedure derived. From this, the variability of the attenuation coefficient α can be generated. Preliminary results show that α may vary by a factor of four or five over distances of 100 μm.

Potential errors and problems have been discovered and additional experiments and improvements to the experimental setup are in progress and we must now show that the measurement techniques and data analysis procedures provide "real" information. Striae are clearly visible at all wavelengths including white light. Their basic spatial frequency does not change radically, at least when changing from blue to green to white light. Further experimental and theoretical work can be done to improve the data collection techniques and to verify the data analysis procedures.