MM 3: Mechanical Properties I

Time: Monday 10:30–11:30 Location: IFW B

MM 3.1 Mon 10:30 IFW B

Periodic Phase Composites in Aluminide Thin Films Produced by Laser Interference Metallurgy - Mechanical and Structural Characterisation — •Peter Leibenguth, Eric Detemple, and Frank Mücklich — Department of Materials Science and Engineering, Functional Materials, Saarland University, Saarbrücken, Germany

Laser Interference Metallurgy is a straightforward means of producing thin film composite materials. By overlapping two or more coherent laser beams on the material surface, an interference pattern can be achieved. Its periodic arrangement of intensity maxima and minima allows the formation of a controlled laterally patterned structure of processed and directly neighbouring unprocessed regions in micronscale. Besides melting, annealing and recrystallisation, the Laser processing can induce the formation of other phases having significantly different properties.

We concentrate on the effects of this treatment on the mechanical properties of multilayered thin films, whose composition allows the formation of mechanically interesting aluminide phases. For this purpose, we use a nanosecond-pulsed Nd:YAG laser with high peak power whose primary beam is split in two sub-beams by an appropriate beam-splitter and mirror setup. The resulting composite consists of a periodic array of hard and ductile phases. Structure determination is performed by GI-XRD and TEM. Using bulge-testing and nanoindentation, the global and local mechanical properties are analysed.

MM 3.2 Mon 10:45 IFW B

Experimental based calibration for strain measurement in silicon with Raman spectroscopy — Natallia Zhlobich, Martin Küttner, Henning Heuer, and •Jörg Opitz — Fraunhofer IZFP-D, Dresden, Germany

Raman Spectroscopy becomes more and more important in research and development i.e. for pharmaceutical, chemical or biological applications. Also in semiconductor or photovoltaic industries Raman spectroscopy on Silicon will be an important method to measure strain and chemical-physical interactions. To increase spatial resolution for near field Raman spectroscopy with a basically weak intensity an optimization problem between fast measurements versus perfect peak quality has to be solved. Different parameters of the experiment are used to improve the quality of Raman peaks and to decrease the exposure time. Applied stress in the samples is calculated with help of a theoretical model for 4 point bending. The dependance between mechanical stress and Raman shift is obtained. The influence of different parameters of the experiment on the interpretation of Raman data is discussed. The results of this work will be used in the further developing of a Scanning Near-field Optical Microscopy technique for stress mapping with high spatial resolution.

MM 3.3 Mon 11:00 IFW B

Anharmonic contributions to the phonon density of states of rock-salt AlN — •Steve Schmerler and Jens Kortus — TU Bergakademie Freiberg, Institut für Theoretische Physik, Leipziger Str. 23, 09599 Freiberg, Germany

The standard approach to calculate the phonon dispersion of crystals by means of density functional theory is based on the harmonic approximation. Unfortunately, this method is limited to 0 K calculations and neglects anharmonic contributions completely.

Molecular dynamics simulations allow to obtain the phonon density of states (PDOS) by Fourier transformation of the velocity autocorrelation function. This route opens the way to study phases at various temperatures and also includes anharmonic contributions to the PDOS.

We compare the results of both methods in case of several AlN phases, which are of recent experimental and theoretical interest. In particular we focus on the vibrational properties of the cubic AlN phase.

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MM 3.4 Mon 11:15 IFW B

Effect of residual stresses on fatigue crack propagation of friction stir welded joints — Torben Fischer[1], •Peter Staron[1], Jorge dos Santos[1], Yu-E Ma[2], and Andreas Schreyer[1] — [1]GKSS Research Centre, Max-Planck-Str. 1, 21502 Geesthacht, Germany — [2]Cranfield University, Cranfield Bedfordshire, MK43 0AL, United Kingdom

Friction stir welding (FSW) is a proven technology for use in airframes. FSW is now seen as a key element for producing cost effective integral metallic structures in future airframe applications. By further understanding and development of the FSW process new applications can be realized leading to further cost and weight benefits for metallic airframe structures, which will make these structures more competitive in the future. Of particular importance is the understanding of the effect of residual stress on the performance of the welded components. In order to investigate the influence of the sample dimensions on maximum residual stresses and fatigue crack growth, fatigue test samples with different sizes of a batch of friction stir welded AA 2195 sheets were tested. A crack-initiating notch was inserted perpendicular to the weld line on the advancing side of the weld. Residual stress measurements have been carried out with the neutron diffractometer ARES-2 at Geesthacht Neutron Facility (GeNF). First results show that the residual stresses depend strongly on the specimen size and that the fatigue crack propagation speed depends on the residual stress state.