High temperature elastic modulus characterisation of titanium alloys
TiC and TiCN using surface Brillouin scattering

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Abstract

Transition metal carbides, nitrides and carbonitrides are a very interesting class of compounds because they have a unique combination of physical properties such as high melting points, high hardness values, high electrical and thermal conductivities and metallic lustre. Experimental information on the temperature dependence of titanium carbide and nitride is scanty, and on titanium carbonitrides practically nonexistent. An investigation of the Young’s modulus ($E$), shear modulus ($G$), bulk modulus ($K$) of these non-textured, non-stoichiometric polycrystalline compounds ($\text{TiC}_{0.9}$ and $\text{TiC}_{0.4}\text{N}_{0.6}$) was conducted as a function of temperature, using surface Brillouin scattering technique (SBS). An approach utilising Rayleigh SAWs and an assumed Poisson’s ratio was used to determine the elastic moduli $E$ and $B$ at room temperature as well as at high temperatures up to 700°C. The variation of the elastic moduli with temperature points to the important influence of the intrinsic phonon-phonon interaction to the total anharmonicity.

Keywords: Laser light scattering, elastic moduli, transition metals, surface acoustic waves, Poisson’s ratio