Study of Elastic Properties of Solids Using a Novel SQUID Detection Technique

M. Heitz, A. Fleischmann, C. Enss

Kirchhoff-Institut für Physik, Universität Heidelberg, D-69120 Heidelberg, Germany

Vibrating reed measurements are a common technique to investigate the low frequency elastic properties of disordered solids. At low temperatures the sound velocity and internal friction of disordered materials are in most cases dominated by atomic tunneling systems. A general problem in the investigation of the elastic properties of such materials is the occurrence of non-linearities caused by the tunneling systems. To enhance the sensitivity and thus to allow measurements at lower excitation amplitudes we have set up a new inductive detection technique. A superconducting reed – or a reed with superconducting coating – is mounted between a field coil and a pickup coil. Changes of the mutual inductance of the coils due to the variation of the reed position are detected by a commercial dc-SQUID which is connected to the pickup coil. To test this technique we have investigated the elastic properties of polycrystalline niobium by simultaneously using the SQUID detection and the conventional capacitive detection method. Already in these first experiments the inductive technique was convincing and showed a comparable signal to noise ratio as the capacity method at excitation voltages one order of magnitude lower. Further improvements should be possible. We plan to use the SQUID detection technique to investigate the elastic properties of condensed rare gas films and structural glasses.