milar to those obtained by the classical pulsed method, but allow in addition the working frequency to be changed. Dispersion curves can easily be obtained, from which elastic constants of the layers can be calculated. Fig. 8a shows the dispersion curves of two SAW modes measured in a thin layer of gold (1.2 μm) deposited on a substrate of $LiNbO_3$.

Using a cylindrical lens ensures unidirectional SAW propagation perpendicular to the axis of the cylinder. Repeating the *V(z)* measurements while turning the sample around the *z*-axis allows the determination of the angular dependence of the SAW velocity, this being in fact a measure of the anisotropy of materials. For example, this method was used to determine whether Al_6Li_3Cu quasicrystals are elastically isotropic (Fig. 8b), and to measure the angular dependence of the velocity of SAW propagating along the (100) plane of a single crystal of Ni (Fig. 8c), permitting a comparison between estimates from the SAM measurements, theoretically computed SAW velocities and Brillouin scattering measurements.

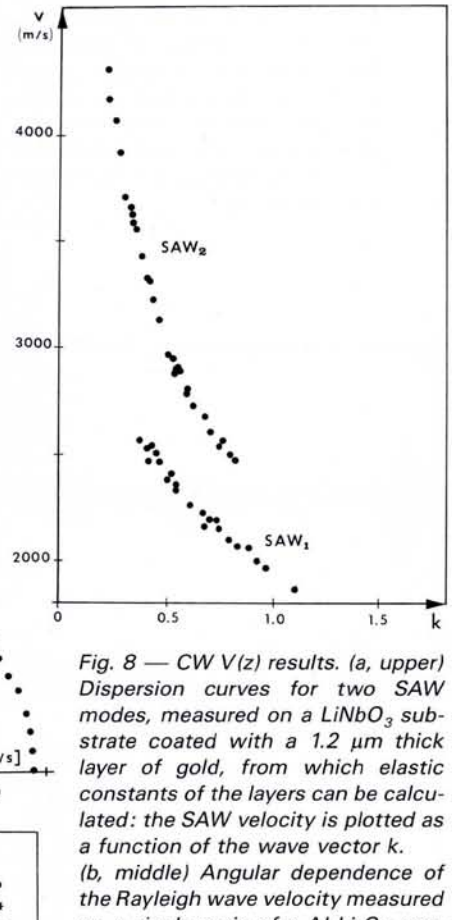
Future Prospects

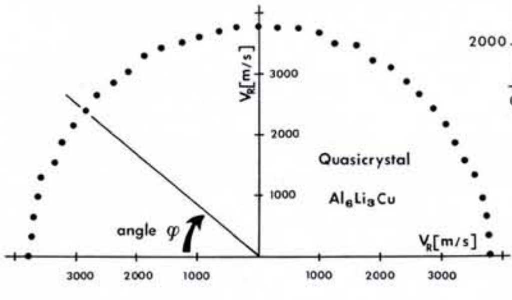
High resolution microscopy

SAM resolution at room temperature is comparable to that of a good optical microscope. Since a limit is imposed by the attenuation in the coupling fluid, major improvements are not expected. A more than tenfold increase was obtained using liquid helium as coupling fluid, but such techniques are not suitable for everyday use. In the field of high resolution imaging, one of the most interesting techniques involves exploiting the extremely good defect detectability owing to the artifacts produced by wave interference.

Defect detection

The first and most logical step in the field of defect detection is phase sensitive detection in the high frequency domain. The most significant achievement belongs to IBM, where phase-sensitive SAM was successfully used at 670 MHz to visualize internal stresses in solids. But the separation of reradiated SAW and direct reflection by signal analysis is also an interesting high sensitivity technique for detecting defects. Such separations have already been realized at low frequencies and only technical limitations need to be overcome in order to generalize the approach in the high frequency range.





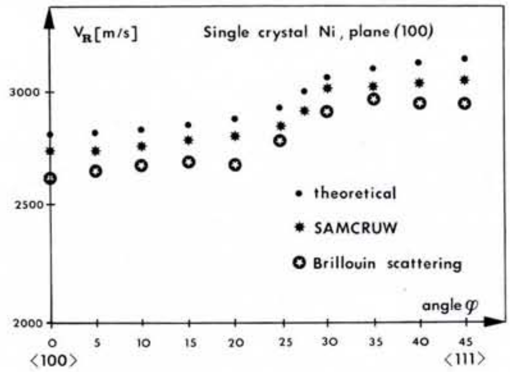


Fig. 8 — CW V(z) results. (a, upper) Dispersion curves for two SAW modes, measured on a $LiNbO_3$ substrate coated with a 1.2 μm thick layer of gold, from which elastic constants of the layers can be calculated: the SAW velocity is plotted as a function of the wave vector k.
(b, middle) Angular dependence of the Rayleigh wave velocity measured on a single grain of a Al_6Li_3Cu quasicrystal by rotating the sample (cylindrical lens at 200 MHz): the data show that the crystal is elastically isotropic.
(c, lower) Angular dependence of Rayleigh wave velocity measured on the (100) plane of a nickel single crystal: results agree with numerical calculations and Brillouin scattering measurements.

Acoustic power is extremely high near the focal point, leading to nonlinear acoustic behaviour, especially in biological samples. Nonlinear parameters can be of great interest in the field of biology and medicine, by allowing discrimination between normal and pathological biological tissues.

Property measurement

Ultrasonic measurements are applied in different fields of solid state physics whenever a physical phenomenon leads to an acoustic loss or to a change of the propagation velocity. Acoustic measurements are currently used to study the mechanical properties of crystalline materials (elasticity, inelasticity, plasticity), structural (martensitic) and several types of solid state phase transformations (amorphous, superconducting, ferromagnetic). Appropriate ultrasonic measurements can be performed locally on a sample surface using an acoustic microscope; they can also be carried out on very small samples or in very thin layers. In this field of potential applications of SAM, the sensitivity and the accuracy of determinations of wave velocity and wave attenuation must be improved. Very interesting applications in solid state physics can also be imagined by using different coupling fluids to allow measurements over an extended temperature range.

FURTHER READING

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100 T Workshop

Professor Laurie Challis of Nottingham University, UK, who helped draft the 1990 report of the CEC Study Panel on High Magnetic Field facilities (see *Europhysics News* **22** (1991) 158), writes to say that the EC Advisory Committee for the Large Installations Plan recommended last February that a Steering Committee should be set up to prepare and supervise the design of a new semi-continuous facility.

A committee has now been established from members of the Study Panel. Its first task will be to organize in May 1992 a 2/3 day workshop to discuss the science which could be carried out at a 100 T facility, the instrumentation that would be needed and possible applications, including materials development. The workshop report will form the basis of the scientific case for a full feasibility study.

These plans were reported on 31 August at the plenary session of the 3rd International Symposium on High Magnetic Field Facilities, and were warmly endorsed.