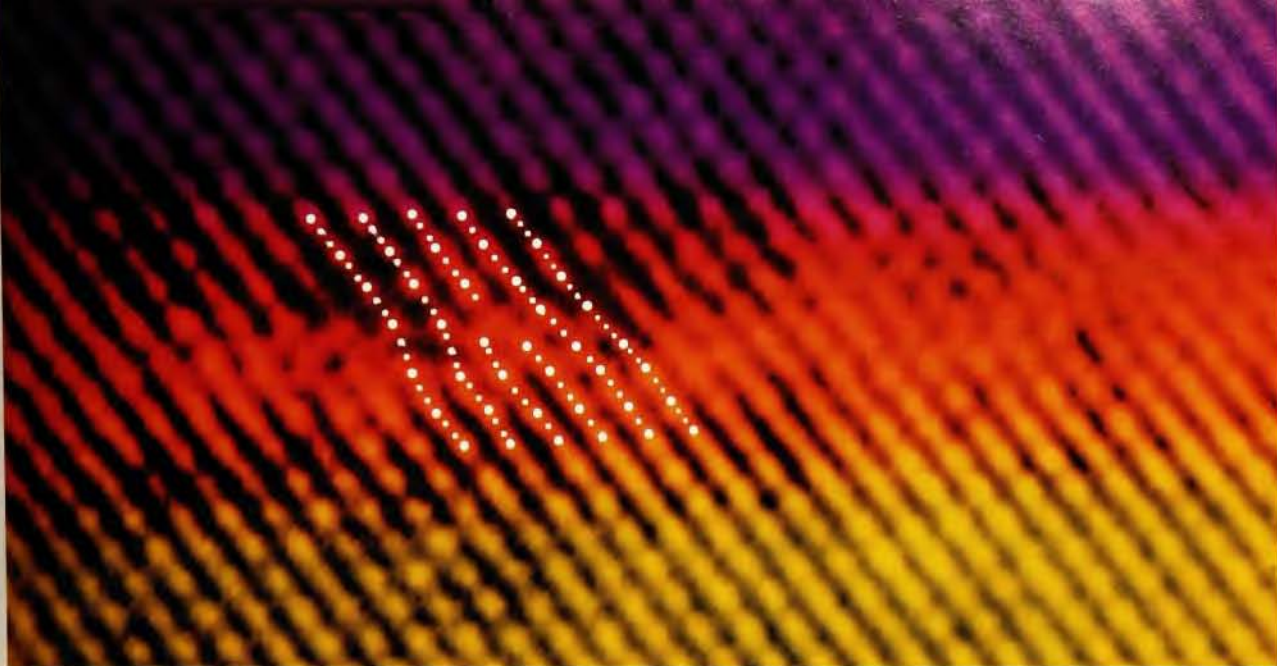




High-resolution transmission electron micrograph of BaF_2 film (artificially colored purple) on a (100) semiconducting InP substrate (yellow). The interface region is highlighted in orange. Bright dots in the image correspond to tunnels between atoms in the (110) direction for both crystals. The interface consists of locally coherent regions separated by misfit dislocations. The white circles indicate a misfit dislocation, which relieves the 5% difference in lattice parameters between the thin BaF_2 film and the substrate. Such high quality epitaxial layers have exciting physical and technological implications and are described in the article by V. Narayanamurti (page 24).

Special issue: Materials research

In the past few years, the focus of research in condensed-matter physics has shifted to exotic materials, novel structural arrangements, surfaces, interfaces and imperfect systems. Advances leading to the fabrication of metal oxide-semiconductor devices and superlattice structures, for example, have made possible the study of quantum-well structures and the discovery of the quantum Hall effect. After a decade of progress with this technology, combined with advances in computer-controlled processing, we can now tailor composition and impurity profiles at an atomic level, monitor the effects that a fraction of a monolayer of atoms has on a surface and control the deposition of atoms layer by layer, capabilities that have already led to the discovery of new physics, such as the fractional quantum Hall effect. (See *PHYSICS TODAY*, July 1983, page 19.) Venkatesh Narayanamurti, in his article on page 24, captures the excitement of the strong interplay between basic physics and technology in condensed matter physics.

The interdisciplinary approach to the synthesis of new materials and to the analysis of their structures and properties has led to the preparation of many exotic materials that have made accessible to study such phenomena as charge-density waves, spin-density waves, spin-glass phases, one- and two-dimensional phase transitions and conducting polymers, just to name a few. Theodore Geballe and Malcolm Beasley, in their article on page 60, show how the

interdisciplinary approach to exotic materials is advancing our understanding of superconductivity. Increasingly sophisticated experimental and theoretical techniques have made it possible in the last decade to understand and control a variety of disordered systems, ranging from isolated defect states to fully amorphous materials with only short-range correlations. There has been especially rapid progress in the area of amorphous semiconductors, as Hellmut Fritzsche explains in his article on page 34.

Major advances in our understanding of nontraditional materials such as conducting polymers, ferrofluids, microemulsions, micelles, gels, clusters and aggregates have come from applications of modern high-resolution scattering techniques, many-body theory and fractal theory. Tom Lubensky and Philip Pincus, in their article on page 44, give a physicist's perspective on this emerging research.

Advances in materials research have also been important in advancing other fields of physics—for example, materials for lasers used in atomic and molecular physics; and materials for detectors, superconductors and magnets used in nuclear and elementary-particle physics. Likewise, advances in many-body theory and renormalization-group concepts have benefited theorists in other subfields of physics, bringing new unity to physics as a whole.

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Guest Editor