been vigorous, multi-institutional and multidisciplinary, addressing both theoretical and experimental aspects. It is to be hoped that this effort, which has been sustained over a decade, will continue to grow to tackle the many challenges that remain in this field.

The expectation that a new type of atomic configuration will automatically lead to new properties is now being realized. This is especially true of electronic properties. In crystals greater purity and perfection lead to improved electrical conductivity. Quasicrystals exhibit just the opposite behaviour. As purity and perfection are improved, they become semiconducting and even insulating! Current Indian research in this direction needs to be intensified.

The deformation of quasicrystals has become an intensive area of research. Japanese work has shown that it is possible to produce quasicrystals in nanometre dimensions embedded in crystalline or amorphous matrices with a vast improvement in mechanical properties over conventional aluminium alloys. Indian expertise is well poised to take advantage of this new breakthrough.

Quasicrystals have proved to be a fertile field of investigation for mathematicians. Papers of great depth and beauty continue to appear exploring the higher dimensional world and beyond the quasicrystalline order. There is a progression from periodic through quasiperiodic to almost periodic structures.

Inevitably an article of this type is not comprehensive either about the richness of the idea of quasiperiodicity or of the extensive Indian contributions. The reader is referred to two reviews for further details[29,30].

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Scanning probe microscopy

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We have discussed the importance of the area of Scanning Probe Microscopy and its likely impact on different types of measurements that can be carried out at nanometer levels. We have talked about the application of STM in the area of nanofabrication and expressed the view that this area needs careful development in the country.

The discovery of Scanning Tunneling Microscope (STM) in 1982 opened up a new area of research. The area is developing and progressing at a rapid rate. Subsequent to the discovery of STM, a number of scanning microscopes have been invented. The most important is the Atomic Force Microscope (AFM). The first question one may ask is why the area has become so important within a few years of its discovery. Definitely the first answer is that it gives atomic level (or nanometer level) resolution at an affordable cost. This is the first requirement of any new microscopy. In addition, it is very easy to adapt it to different types of sample environments like ultra high vacuum, low temperatures, high magnetic field, etc. which are nontrivial in other types of high resolution microscopy. There is yet another aspect to this new form of microscopy. A number of different probes can be used for scanning giving different 'views' of the same subject. This is the origin of the general name of Scanning Probe Microscopy. Sometimes even the same probe can be used to do more than one type of microscopy by tuning to different points of the conductance curve. For instance, if one takes a constant current scan of a surface one gets the topography but if it is a surface of a superconductor keep in a magnetic field and one scans by keeping the maximum of the tunneling conductance constant one would get the flux lattice!

In addition to microscopy, there are two other extremely important applications of this new area. First, it can do scanning spectroscopy of the surface using electrons with energy typically within an eV with very high resolution (much better than 0.1 meV). Second, it can measure properties (like mechanical and electrical properties) at a nanometer level. In particular one can mention recent works on studies of friction at nanometer level. Third, one can do modification of surface (like nanoindentation) and create atomic level structures. In my opinion, while microscopy will be a popular tool mainly with non-physicists the last mentioned applications will be popular with physicists and even with a section of engineers.

In our country this is a field which has just started. Given the importance of the field more groups will enter the field. It is definitely desirable that proper funding is given to this area. In particular, given the very high price of the equipment it is good if groups are encouraged to build their own equipment which can be done at a fraction of the cost of imported equipment. In addition, it is also correct that many times a physics type experiment needs features which are not available in commercial instruments. For this reason it is strongly advisable that the groups willing to build their apparatus should be given preference.

It will be good to sketch briefly the published works from India in this field. Most of the published works are essentially room temperature imaging of oxide superconductor surfaces, C_{60} and other exotic objects like carbon nanotubes etc. These works are all based on imported STMs. These groups have also done some spectroscopic studies. In particular, regarding metallicity of small particles, interesting information had been obtained from these investigations.

The low temperature investigation was done from one group only. This is a home made microscope. The emphasis of this work is on spectroscopy and studies on small junctions. Significantly new results were obtained from these investigations.

From the above it is clear that this area is very weak in this country and a good deal of investment will be needed to promote the area. It is an interesting as well as an important area with potential for first rate, basic as well as applied science. This should get reflected in the scientific planning of national laboratories as well as of the academic institutions. Particularly since this is becoming an area of its own it will be desirable to appoint people who have specific training in these areas and prior exposure. This is important because it will nucleate new activities and will cut down amateurism which invariably comes about when an area is new and there is shortage of trained manpower.

One particular sub-field of this area which will have tremendous technological fall-out is the use of STM in nanofabrication. There is no awareness of this in the country amongst the managers of high technology. However, in a decade's time we may rise up to find that a high price has to be paid for a technology which could have been developed at a fraction of the cost. It is therefore strongly felt that steps be initiated to start activities in this direction. It may need some level of infrastructural development and financial investment but will definitely pay off in the long run.

Crystals for nonlinear optical applications

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The advent of high field density light sources coupled with the recent advances in the materials technology has led to rapid progress in the field of nonlinear optics. This article deals briefly with the materials development that has taken place all over the world during the last forty odd years and reviews the present status of this activity in our country.

In its long history, optics, until the advent of lasers remained linear. The tenets of linear optics are based on the assumption, which provides the linear dependence of polarization wave generated in the medium on the interacting electromagnetic field. However, when the radiation field is large, the induced polarization would become nonlinear and its dependence on the radiation