Report of the Scientific Council of the INFM center Coherentia

The Scientific Council of the INFM center COHERENTIA visited the center May 7-9 2003 to monitor progress during the initial period of the contract. Members of the committee present were Boris Altshuler (Princeton University), Tord Claeson (Chalmers University), John Kirtley (IBM Research), and Colin Webb (Oxford University). Unable to attend was Bernard Raveau (Caen Cedex). On the whole, we got a very positive impression of the progress of this center. We would like to take this opportunity to make a few comments:

COHERENTIA is an interdisciplinary center, including experimental and theoretical physics, atomic and condensed matter physics, materials science, and electrical engineering, combining groups in several laboratories in Naples, Rome, and Salerno. The INFM funding acts as a catalyst to enable strong areas of competence and personal resources at universities to interact between each other and with other institutes and industries. The educational value of a strong research base and of continuous renewal in the rapidly changing university environment should be emphasized. We note that a change in the organization of INFM has been discussed. Whatever is decided, we hope that the successful and stimulating format of interaction between different universities, different disciplines, and with industry and society, as well as the efficient, independent local organization, that enables changes to be quickly implemented, will remain. This has proven to be a great asset in the COHERENTIA work up till now.

COHERENTIA combines techniques, methods and concepts from two different “coherent” fields: laser optics and superconductivity. This means that researchers from different disciplines are inspired to change their orientations and apply their expertise in the service of a larger, cross-disciplinary field. The Science Council recognizes the danger in having widely separated groups acting in different disciplines: there could be a tendency for each group to work on its own. However, the leadership of COHERENTIA is well aware of the problem, and different actions to “glue” the different efforts together have been applied. For example, for a long time there have been fruitful Christmas meetings between the superconducting communities in the region. These have been complemented by COHERENTIA meetings where the different groups participate. Of special importance is that the graduate students of the program get a feeling of working together and exchanging ideas. We encourage special doctoral student meetings.

The first of the meetings of the Scientific Council of COHERENTIA had an admirable breadth and depth in its presentations. As always, the time to meet and discuss the progress of the different groups with the young team members at a poster session was a bit short. We appreciate, however, the effort by the COHERENTIA leadership to let young researchers and group leaders present their activities during poster and oral presentations as well as in the laboratory tours. Although it is too early to judge the quality of work of either the core or seed projects, we found some of the presentations especially interesting. One example of a refocused effort that seemed to have particular promise was the study of 3rd harmonic generation at the surface of strontium titinate substrates, with the view of identifying the topmost layer, with applications to controlled growth of cuprates and mangenates on these substrates.

A second example of an especially interesting refocused effort was the time, space, and energy resolved study of the plume generated above the target surface during femtosecond pulsed laser deposition. This study seemed both very promising from the viewpoint of basic science, and with an eye towards possible improved film growth. It is clear that most of the pulsed laser deposition (PLD) has been carried out using excimer lasers with nanosecond pulse durations. The work using femtosecond lasers has only just been started due to installation problems with the Ti:sapphire laser. The work so far has adduced evidence for the existence of nanoparticles in the ablation plumes. It will be instructive to investigate what effect such nanoparticles have on the quality of the films deposited and whether the nanoparticles can be eradicated or at least reduced

by post irradiation of the plasma plume by a crossed beam from an auxiliary laser. Certainly it would be fruitful to compare the results of laser plumes created with conventional nanosecond and femtosecond lasers, and to explore whether the frequency doubled femtosecond laser is more effective than the fundamental beam in producing plumes with the desired properties. If a higher repetition rate femtosecond laser were available, it would be also very instructive to investigate pulse adjacency effects to see whether the remaining ionization from one pulse has any influence on the ablation conditions in the succeeding pulse.

An example of a successful cross-group collaboration of the type that should be encouraged was that involving the extremely thin high-Tc cuprate films grown by the Tor Vergata group. These seemingly unique films represent a very promising avenue of research. We would like to encourage the exploration of electric field gating and spin injection, which may show exceptionally strong effects in such thin and high quality films. We note however that there were safety issues in some of the laboratories we visited. For example, there was a cylinder of helium/fluorine or neon/fluorine mixture in the middle of a lab which had no forced ventilation or gas cabinet surrounding the high pressure gas cylinder - and no gas masks for emergency use. Also, laser optics were mounted at eye height on structures that could not be considered safe for use in a laser laboratory. Some of these safety issues were discussed with the lab personnel at the time of our visit, and hopefully action has been taken on them since then.

A large fraction of the capital investment in COHERENTIA during this initial period will be in a modular thin film growth and analysis system. This system has the potential for providing a large number of high quality samples for this effort. However, we would like to caution that it is important that continuity of expertise in using this system be assured through a professional, either on the PhD or advanced technician level, who is responsible for this system. We would also like to propose that a user committee be set up, to ensure that the use of this system is fairly and efficiently allocated.

In conclusion, we believe that the INFM center Coherentia is off to a good start, and look forward to following its progress in the future.

Signed:

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