

Report of the Scientific Council of the INFM center Coherentia

In the occasion of the WOE Conference in Ischia, Members of the Scientific Council of COHERENTIA visited the center Oct. 15, 2006 to monitor the progresses of the Center. Here are reported the resulting considerations.

The complicated MODA apparatus (pulsed laser deposition of oxide films + several advanced instruments for analysis of the thin films *in situ*) is operating since one year. The analysis instruments have been tested and function, maybe even better than expected. (As a side information, supporting the concept, Univ. of Twente builds a very similar cluster machine.)

The PLD plume has been studied in detail using a fast CCD camera and expertise from the fs laser group in Naples. The development, in time and space, of the plume depends upon oxygen pressure and, to some extent, the substrate temperature. The maximum intensity of the laser induced plume remains at the target position when pulsed in vacuum. As the oxygen pressure increases, the maximum intensity moves from the target to the sample position as the plume expands. It remains at the target surface for some microseconds. If the oxygen gas is heated by the substrate heater, the plume intensity is affected to some degree.

Another initial study has been of STO substrates of different orientations. Si is not the prime substrate choice for oxide films. Oxide substrates have to be used – and these are not yet fully characterized. Ti-O terminated surfaces can be prepared by preferential wet etching. However, Sr diffuses to the surface at high anneal temperature and forms Sr-O nano-crystals. There is no good way of forming Sr-O terminated STO surfaces. The message is that single crystal STO surfaces are not uniform and variations will affect the subsequent growth of oxide films.

YBCO, LSCO, LSMO, and STO films have been deposited and analyzed. STM measurements on LSMO at room temperature show that the surface is a mixture of insulating (non-magnetic) and conducting (magnetic) regions, spreading over two different length scales. No cross-contamination between the different PLD sequences has been noted. It was seen that Ni from the Inconel substrate holder affects the sensitive reconstruction of a Si surface, but no effect was seen on superconducting or other properties of oxide films.

As you remember, the Balestrino group in Rome builds so called infinite layer high temperature superconductors by stacking charge reservoir and infinite layer blocks. I found a presentation interesting, where Aruta (one of the new senior researchers) pointed out how the electronic signature of the charge reservoir remains almost unchanged in the superconductor, pointing upon the dependence of apex oxygen atoms. Measurements were done at the synchrotron light source in Trieste. No sizable field effect was seen by researchers in Naples who applied electric field to the artificial superconductor.

I mainly discussed the MODA facility during my stay as I was curious to know how it worked. The main part of the COHERENTIA resources goes to that activity. I know that the junction parts of the program work very well, although less well financed. The researchers in those work packages have obtained good international visibility and I guess that you have read some of the papers.

The COHERENTIA budget remains at €3M per year (no inflation compensation, no annual cut; being a member of CNR may perpetuate the activity). It finances 1 director, 4 senior (tenured) researchers (up from 2), 10 (tenure track) researchers (instead of 12), 10 post-doc positions, 5 administrators, and 2 technicians. There are 25 associated university researchers (down from about 30) in Naples, Rome, and Salerno (these supervise PhD students that are sponsored by COHERENTIA).

The consortium is organized within about the same work packages as previously. The optical research has been more closely integrated into several of the work packages and is oxide oriented. It seems like the projects of ZnO nanowires for gas sensors and of electron transport properties of organic materials (theoretic back-up to a separate large experimental program) have grown somewhat during the past years. The miniaturized HTS filters for telecommunication were successful from the point that the desired technical specifications were met. However, the customer did not believe that the filter was competitive economically and the project was terminated.

A drawback of the CNR organization is that the career way for senior researchers is delayed compared to the INFN organization. In CNR, age determines promotion rather than achievement.

Elisa Molinari, who got an INFN consortium at the same time as COHERENTIA, will head an umbrella organization for the 20 odd INFN consortia (within CNR). Presumably, there will be an evaluation chaired by Parisi.

In conclusion, you can be assured that you have got the correct impression from the yearly COHERENTIA report that you have read previously – COHERENTIA develops well scientifically.

On behalf of the Scientific Council,

Tord Claeson
Micro Technology and Nano Science (MC2)
Chalmers University of Technology
SE-41296 Gothenburg, Sweden
tord.claeson@mc2.chalmers.se