

“ILRES” - High resolution optical and electron beam patterning processes with new ionic liquid based resists

The big success of the semiconductor industry has been strongly connected with the ability to consistent improvement of patterning (usually lithography) resolution. This would lead to more computing power of electronic devices at lower price. The requirements for ever-smaller devices have been driving development of all kinds of resists.

At the same time new area of technology – green technology – focuses on the designing of processes and methods that minimize the use and generation of hazardous substances. Last years one can see more and more interest in environment-friendly alternatives to conventional resins for all kinds of lithography. More ecological methods and materials must meet certain conditions but at the same time the same process requirements must be maintained. The most important are always quality, resolution, sensitivity, stability and the price. Lately, the green lithography research is evolving towards novel functional materials to find an ideal custom-tailored material platform for a wide range of applications.

The key objective of the project is the development of novel, high resolution and sensibility photoresists for (i) optical lithography technique, (ii) laser printing and (iii) e-beam resists for electron beam ultrahigh resolution patterning. The new method will be a unique new combination of solvent-free (or solvent limited) high resolution resist adapted and modified well known techniques (e-beam and UV beam lithography and laser printing). The new ionic liquid lithography (IL-Lithography) with reduced environmental impact, proposed in the project, will have a significant implication on technology for integrated electronic and photonic fabrication of circuit boards. A fundamental research in ILRES project on ionic liquids design and its impact on the pattern will help to understand molecular interactions, correlation between molecules size and resolution, and further production processes. The project will have significant contribution to high resolution, and more ecology-friendly, technology standards.

ILRES proposes new approach for future integrated circuits patterning technology by making the use of a unique new solvent free materials– room temperature ionic liquids (RTIL) able to change the properties under beam illumination. As the material can be composed from many small molecules, or short polymer chains, the modification of properties like hardness, flexibility, solubility, resolution and hydrophobicity can be adapted. The ILs due to the specific molecular form, present unique architectural platform, on which one can modify the properties of ions matching material requirements.

During the course of the project we will perform:

- chemical synthesis and modifications of ionic liquid based resist
- optimization of each step of patterning process: deposition, polymerisation, development, etching and lift-off.

We aim in the method with important advantages:

- solvent free or solvent limited process
- ultrahigh resolution for e-beam patterning (tens of nanometers)
- high resolution and high aspect ratio optical patterning
- compatibility with following processing (fabrication steps) like etching and deposition
- water based removal.

The aim is to create stable and repeatable method to overcome different fabrication challenges.