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P86 - Micro-IBA analysis of Au/Si eutectic "crop-circles"

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When a thin (few tens of nanometers) gold layer is deposited onto the native oxide of a silicon wafer and is annealed at temperatures greater than 600℃, peculiar circular features with a regular polygon at the centre of each circle, reminiscent of so called "alien"crop circles, can be observed.
In a recent paper [1], a systematic investigation on the role of the annealing temperature and of the Au layer thickness allowed the formation mechanism of these circular nano-structures to be properly modelled: at high temperatures, the native oxide, which is a natural diffusion barrier isolating the deposited film from the substrate, weakens and narrow channels open; the resulting Au/Si interdiffusion lead to an AuSi eutectic layer with a thickness determined by the thickness of the deposited Au film.
The central polygons occur in correspondence of the oxide channel openings and represent regions filled with a AuSi alloy which, during cooling, segregated into pure Au and Si. The shape of this central polygon is dependent on the Si wafer orientation, e.g. a square for (100) or a triangle for (111) orientations. Their typical dimensions vary in the range of few micrometers and are related to the diameters of the circles, which extend up to few tens of micrometers.

In order to get more insight into the "crop circles" formation mechanism, micro ion beam analyses were carried out at the Ruder Boskovic Institute of Zagreb on samples prepared on Si (100) substrate covered with 50 nm Au thin film and annealed at 600℃. 4 MeV C ion raster scanned beams focused down to few micrometer spot size were used to image the elemental composition of the eutectic Au/Si circles and of the Au central regular structure.

[1] T. S. Matthews et al. Phys. Rev. Lett. 108, 096102 (2012)

Primary author: Prof. VITTONE, ettore (University of Torino, Department of Phyics, Torino, Italy)

Co-authors: Dr BATTIATO, Alfio (University of Torino, Department of Phyics, Torino, Italy); Dr AMATO, Giampiero (Istituto Nazionale di Ricerca Metrologica INRiM, Torino, Italy); Dr CROIN, Luca (Politecnico di Torino, Torino, Italy); Dr JAKSIC, Milko (Institute Ruder Boskovic, Zagreb, Croatia); Dr VIGNOLO, Umberto (University of Torino, Department of Phyics, Torino, Italy); Dr SIKETIC, Zdravko (Institute Ruder Boskovic, Zagreb, Croatia)

Presenter: Prof. VITTONE, ettore (University of Torino, Department of Phyics, Torino, Italy)

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