ESRF	**Experiment title:** Exploration of X-rays Nano-Patterning on TiO_2	**Experiment number:** MA-3506
Beamline: ID16B-NA	**Date of experiment:** from: 10/5/2017 to: 15/5/2017	**Date of report:** 02/03/2020
Shifts: 15	**Local contact(s):** Damien Salomon	*Received at ESRF:*

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Report:

We have pubished the results correponding to this experiment in the paper by L. Mino et al. [1].

It is well known that intense synchrotron beams can alter the state of materials, but this effect is generally considered undesired radiation damage. We have investigated the effect of local irradiation of TiO_2 rutile single crystals at ID16B-NA by means of a 56 × 57 nm^2 nanobeam at 17.4 keV. Aside from a transient increase of conductivity due to a photovoltaic-like process, a nonvolatile localized change of resistance by about 4 orders of magnitude has been measured after X-ray exposure. This effect can be ascribed to the local generation of oxygen vacancies by the X-ray nanoprobe, which are subsequently ordered by the electric field applied during the acquisition of I–V curves. These results indicate that intense synchrotron beams could create oxygen vacancies in materials with tightly bound oxygen atoms, highlighting that X-ray nanoprobes could become an effective tool for oxide nanofabrication, able to locally tune the material resistivity. For instance, since the localized presence and migration of oxygen vacancies is an essential requisite for redox-based memristive devices, the possibility to locally induce oxygen vacancies could represent a novel tool for the production of oxide-based memristive devices, replacing the problematic electroforming step.

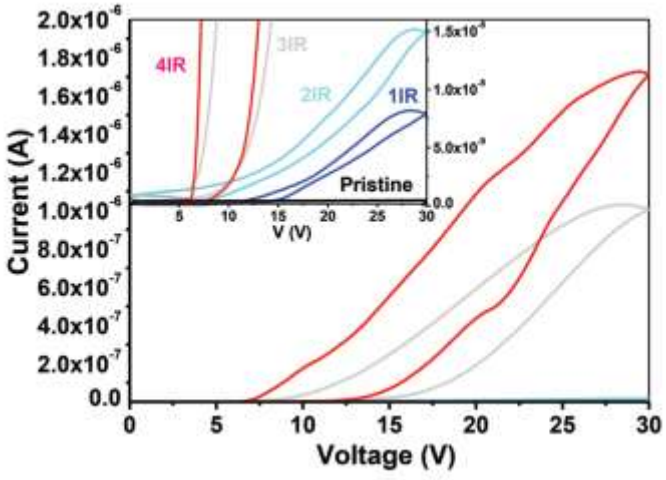

Figure 1: I–V curves acquired after each of the four X-ray irradiation steps (1IR, 2IR, 3IR, and 4IR) on an irradiation line between two Au electrodes at the maximum photon flux (6.7 × 10^{10} ph s^{-1}).

References

[1] L. Mino *et al.*, *Adv. Electron. Mater.* **2019**, *5*, 1900129.