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## Active Sites of Te in Hyperdoped Si by Hard X-ray Photoelectron Kikuchi-Diffraction

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n-type doping of Si by the deep chalcogen donor Te in excess of the solubility limit was recently demonstrated to lead to hyperdoped material [1]. Our investigation by hard x-ray photoelectron spectroscopy (hXPS) reveals at least two different Te species with different binding energy and systematically varying concentrations with increasing ion implantation dose. At the highest doping we study the photoelectron scattering patterns using hard x-ray photoelectron diffraction (hXPD) [2]. Substitutional site occupation of both Te monomers as well as dimers is identified with increasing binding energy leading to the main features in the XPS spectra. The sharp hXPD patterns allow the detailed analysis of the local surrounding of the dopant atoms [3]. At the lowest binding energy, an additional species is found and the distinct, rather diffuse hXPD pattern at this binding energy suggests the assignment of this component to a small fraction of Te in clusters.

### References

- [1] M. Wang et al. Phys. Rev. Appl. 11 054039 (2019) and references therein.
- [2] O. Fedchenko et al NJP 21, 113031 (2019); [3] O. Fedchenko et al NJP 22, 103002 (2020).

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