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The idea of XANES investigations was born during the full project execution after a study of several up to date publications associated with the presence of manganese in silicon. The basic motivation was provided by a paper published by the authors from the Institute of Physics of the Polish Academy of Sciences [Rad. Physics & Chemistry, 80 (2011) 1119], in which X-ray absorption structure was studied in silicon implanted with manganese at elevated temperatures and the results compared with various models simulating the geometrical structure of the nearest neighborhood of manganese atom.

Our effort was the first attempt of comparing the effects of standard thermal annealing and pulse annealing associated with silicon melting and crystallization. The simulated calculation has shown that the required X-ray intensity is attainable only in synchrotron equipment. To execute the idea, a suitable research program was proposed for DESY synchrotron in Hamburg and after its acceptance the measurements started.

It was soon recognized that the manganese spectra from the investigated samples were identical to the background spectra where the presence of manganese resulted from the material used for sample holder (duralumin) and scattering in the experimental chamber. Accordingly, in the second stage of investigations a special sample holder was designed which eliminated the presence of manganese.

The preliminary results of the measurements before final analysis are shown in the figure below.
The individual notation in the figure mean:

C48 – sample implanted, molten,
C94 – sample implanted with manganese,
C52 – sample implanted with manganese, annealed At 800°C for 10 min

The preliminary analysis of the results reveals that:

1) the absorption edge is shifted and has various forms thus indicating differences in the density of states at the Fermi level, likely to result from an energy transfer, i.e. different valences or different surrounding of Mn atom,
2) The spectra Mn:Si show enhanced second maximum in comparison to metallic manganese (Mn foil) originating from reasons as in 1), different symmetry around Mn atom,
3) sample C48 displays a second peak at the slope between 6550 and 6600 eV, interpretation as in 1), 2),
4) decay of two maxima in C94 and C48 manifesting increased disorder
5) a shift of the maxima reflects different interatomic distances.