Contribution of numerical simulation to characterize the shape of the diffracting volume and define the mean position analyzed by synchrotron radiation

Jean-Michel Sprauel[a*], [a]*CIME / EA(MS)², I.U.T. Aix-en-Provence, Av. Gaston Berger, 13625 Aix-en-Provence Cedex 1, France*
E-mail: sprauel@iut.univ-aix.fr

Synchrotron strain or stress evaluations are reliable when the probe volume is completely immersed in the studied material. However, near surface measurements or acquisitions carried out close to interfaces are much more difficult to analyze. Under these conditions, it is indeed very difficult to characterize precisely the volume analyzed by the radiation and finally to define the measured depth.

This study shows the contribution of numerical simulations to solve this problem. It demonstrates that a complete modeling by a Monte Carlo method allows defining precisely the size and shape of the probe used. It permits then predicting the evolution of the diffracted intensity versus the position of this volume in the matter. The calculations finally let to define the real analyzed depth, accounting for the local conditions of diffraction and absorption in the material. The experimental procedures implemented thanks to the numerical simulations thus improve the space resolution of synchrotron strain or stress evaluation methods and reduce the uncertainties of the results. To this last end a new method for a global analysis of stress fields was developed which greatly improves the precision of measurements.

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