Diamond crystals under extreme heat load

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The power generated by insertion devices in 3rd generation synchrotron light sources continuously increases particularly when using in-vacuum undulators with very small gap, super-conducting wigglers or undulators, and when increasing the storage ring electron beam current. This increasing heat load is an on-going challenge for the design of beamline optics especially for crystal monochromators with relatively high incidence angles. For the forthcoming 4th generation light sources, such as X-FELs, the time structure and extremely high peak power will be even more challenging for the design of crystal monochromators. To cope with the high heat load created at the 3rd and forthcoming 4th generation light sources, diamond crystal is a good material for high-heat-load X-ray monochromator thanks to its excellent thermal and mechanical properties: high thermal conductivity, low thermal expansion coefficient and low power-absorption coefficient. In this paper we will review some of thermal and mechanical properties of the diamond crystal. Then we will present finite element simulation results on the thermal deformation of the crystal under X-ray heat load. Comparison between diamond and silicon crystals will be made.