Thermal fatigue test of Glidcop with undulators power

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The most critical thermal absorber in a storage ring is crotch absorber since it is very close to the X-ray source - bending magnet and in quite confined space. The power density on the crotch absorbers in the 3rd generation light sources like the APS and the ESRF reaches several hundred W/mm2. Similar power densities are seen by photon masks and shutters in the front-ends. The 1st generation of crotch absorbers at ESRF was made from Glidcop, and presently operates close to yield strength of the Glidcop. In the development plan of the light sources, ESRF has a project to upgrade the storage ring from 200 mA operation currents to 300 mA. APS also has a long range goal of increasing the beam current from 100 mA to 200 mA. Consequently, the radiation power density will increase by a factor of 1.5 at ESRF, and by a factor of 2 at APS. Now the question is: “Can the present thermal absorbers at ESRF and APS accommodate with the power increases?”, or “Can the overly conservative design criteria used at APS and ESRF for the thermal absorbers be relaxed by a factor of 2 and 1.5, respectively?” To answer these questions, APS and ESRF are collaborating on thermal fatigue studies of Glidcop. These studies consist of thermal fatigue cyclic tests with undulator power, non-linear finite element analysis (FEA) including temperature-dependant elastic-plastic behavior, creep effects and full cycles of transient analyses. This paper focuses on the thermal fatigue tests and analysis of test results. A total number of 14700 thermal fatigue cycles were made and some fatigue cracks were observed on the surface. Nonlinear FEA and fatigue analysis results are presented in a separate paper in these proceedings.