Closed form solutions for a contamination barrier, a filter, and a window for an x-ray beamline at the Advanced Photon Source

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A general, one-dimensional analytical solution for thermal stress was formulated for a thin disk with an axisym-metrical, Gaussian-distributed heat flux. This solution helps to predict the temperature and thermal stress as well as optimizes the design of a vacuum contamination barrier for x-ray beamlines at the Advanced Photon Source.

A general, two-dimensional analytical solution to the thermal problem was also formulated for a thin plate with Gaussian-distributed heat flux. This solution helps to predict the temperature as well as to optimize the designs for the filter (made of graphite) and window (made of beryllium) for x-ray beamlines at the Advanced Photon Source.

Parametric studies were performed to determined the worst-case scenario for the above components. The calculated temperature and associated thermal stresses are also reported and verified with a commercial finite element code ANSYS.