From: Peter Sievers
To: Klaus Hanke
Subject: Ho/H-Dumps
Date: 23 April 2013 17:14:04

Hello Klaus,

Here some comments on the review and in particular, on the information provided in additional documents.

-Si-C is certainly a good material. Temperatures and thermal stresses at normal operation look ok? Si-C is a Ceramic, rather brittle (low resistance to traction). Therefore a failure may occur with the "worst case"-incident? Are the instantaneous temperatures and stresses known for this case? Thermal shock and vibrations at 100 micro-s rise times may be small.
Since this is a rare event, thermal fatigue should not occur?
-Other low electrical conductivity metals, like Ti-alloy Ti-Al-6-V are still too conductive? It has, of course, also a bad thermal conductivity. Si-C, if I remember well, is a kind of semi-conductor, with thermal and electrical conductivity, depending on temperature. To be checked?
-Molybdenum is selected as the mating material, because of the thermal expansion coefficient. Others, like Zircalloy, used in reactor technology , and Tantalum (somewhat higher th. Expansion) may also be candidates?
-Bake out (if required) could be arranged by brazing metallic, mineral insulated, radiation hard coax-heating cables into grooves machined into the Si-C? How to protect the environment around the 200 oC-dump???
-With no active cooling and 2% beam, the surface temperature is nearly 160 oC? The Si-C might stand it, but again, its environment, who has to be kept cool and has to absorb the radiated power? Some, even "slobby" active cooling should be accepted.
-The "worst case" is very rare. However, some thermal transients, involving transient thermal stresses are provoked by beam trips, beam starts and beam stops, where the dump rises from room temperature to steady state or from there back to room temperature. These may occur more often. Can this lead to fatigue?
-There was the question, why not send the dumped beam through a window onto an external dump. The window would add a risk factor and the vacuum chamber between the circulating beam and the edge of the outside dump may also be hit by the beam. Not a good idea!
-I believe that, with some R+D, the brazing of Si-C can be managed (Many ceramic-vaucuum feedthroughs are available, and work even after bake out).
-DPA's and radiation swelling. How long will it take to accumulate 0.5 DPA? Radiation damaged metals can sometimes be healed by annealing to higher temperatures. For Si-C it may be difficult.

So, in conclusion, some loose ends may still have to be checked, but I feel comfortable with Si-C. Graphite, if possible, to be avoided.

Kind regards,

Peter.