Liquid Metal PFC Discussion Summary

Thanks to Neil Morely for taking/making notes!

Three main classifications of systems:

1. Fast moving self cooled – cm-thick flow as mentioned by Dick Majeski
2. Slow or stagnant systems cooled from behind -- very thin Li film and thermoelectric-driven flows fall here
3. Evaporation assisted (must still condense somewhere and be removed). e.g. capillary pore system

Two ways to utilize:

1. Divertor only
2. First-wall and divertor

Different types might be suited for different LMs and different motion inducing techniques and different issues.

Additions to lists given by Ruzic

Advantages of Li

Should include edge recycling as an advantage

Flowing conductor may also help stabilize plasma is fast flowing cases

Disadvantages of Li

Should include reactivity, safety, difficulty of development in water cooled devices as a disadvantage or limitation.

Temperature limitation for Li systems still really needs to be addressed.

- Perhaps wall/divertor can be operated cooler than blanket. For FW this seems more difficult.
- What sets cold let temperature in the power cycle or materials (e.g. FS embrittlement)
- Should consider divertor only

Disadvantages of solids

Tritiated dust formation.

Will liquids form “dust” either from droplet ejection or condensation of evaporated materials

IFE work should be co-opted

There has been past work on heat transfer in thin films in IFE (and many other areas). See Georgia Tech thesis: Tim Koehler ~2008

Continued Discussion

Degree of recycling reduction needed – thus tritium handling

Many good results come merely by reducing recycling from 99% to 90%

Even the full-blown high-confinement L-mode (theorized) only needs 50%

So how much tritium has to be handled and returned in what time frame?

Sn and SnLi

Is there a possibility of low vapor pressure using SnLi but still get Li's recycling benefits?

Should we analyze Sn cooled from behind as an option?

Is there other Sn or SnLi work that should be undertaken (edge transport calculations.)

Capillary pore systems

Advantage in Li safety is reduction of overall LM volume.

Can take high heat flux without damage to underlying solid surface – 650C operation!

Limitations – need cold zone area larger than heated area to reduce effective heat flux.

Liquid must drain from this cooled zone.

Plasma needs to handle the flux of Li through edge from hot to cold zone

Future Discussion

What to do differently next year or in future years?

Review Paper or report describing state of the art, together with gap analysis
(Have a special topic call at least to go further in discussions)

Focus a little on Sn issues as a bracket to Li
Temperature limitation for Li could be good near term focus.

- Can plasma handle a Li evaporation flux equivalent to reactor level heating?
- Will it be collected in a practical drain surface without negatively impacting core plasma operation?
- What type of vapor shielding and impact on other plasma edge and core parameters will result?

Determine real recycling behavior of high flux Li surface, evaporating Li surface, etc. Recycling coef. estimates?