Liquid metal issues related to surface chemistry and physics

- Predictive capability for substrate wetting
  - Using capillary forces to distribute, retain liquid lithium
  - Very good wetting of the porous or textured substrate is needed
    - » Scale size of surface structure: 50 - 100 microns (porous material, CVD columnar surface, linear channels, layered mesh, tungsten “feltmetal”)
  - Our wetting tests are entirely empirical
- “No flow” (nonwetting) zones to limit the flow of liquid lithium
  - Lithium has, in the past, wicked out of containment and coated electrical breaks, dripped onto vacuum windows, etc.
  - We have not been successful at finding a coating material which blocks creepage
- Development of a liquid lithium-compatible insulating coating for surfaces and the interior of delivery pipes would be a major advance
  - MHD effects make it difficult to use liquid lithium in high magnetic fields
    - » A primary reason that compact tritium breeding blankets for reactor use are not feasible
  - Useful for PFCs as well as breeding blankets

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Surface science issues for liquid metal plasma-facing components

- Surface issues for liquid metals
  - Plasma ions only sample top few hundred Å of PFC surface
  - Electrons only sample top few Å
    - » Recycling, secondary electron emission characteristics are determined by surface coatings, if present

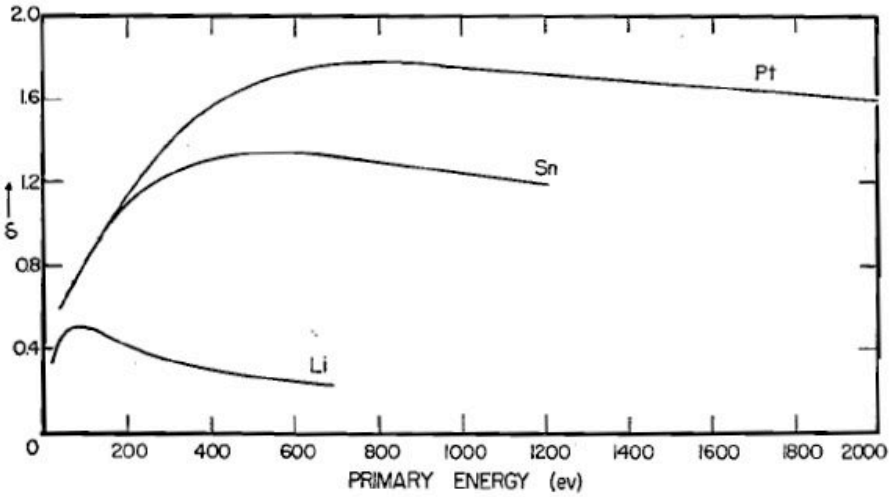

FIG. 2. The total yield as function of primary energy for some metals; for references, see Table I.

- Surface coatings evolve very rapidly
  - Ex-situ analysis of dubious value
  - In-situ analysis difficult, but state-of-the-art is advancing to this
  - Example: MeV proton-beam based analysis of PFCs in an MIT tokamak experiment (C-mod)
- Between-shots analysis of PFC surface conditions is needed for LTX, NSTX
- Ideas are welcome

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