The influence of out of band radiation on EUV optics contamination

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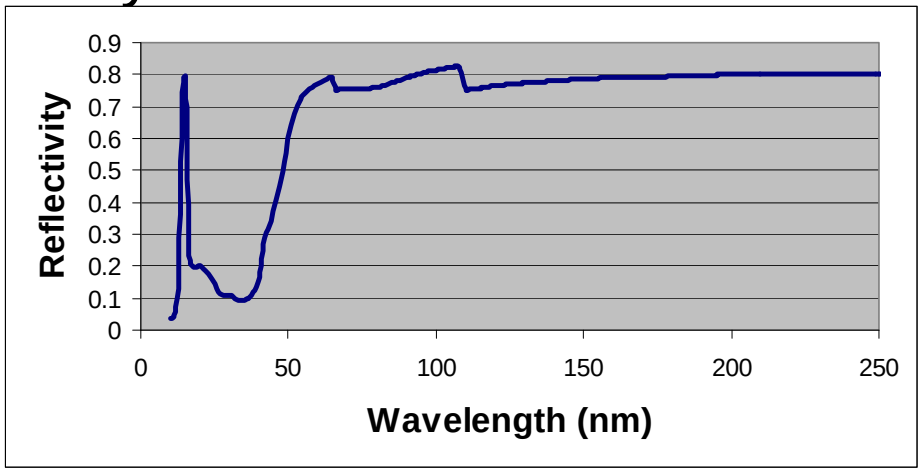
The problem with out of band (OOB) radiation

- There is vacuum ultraviolet radiation from the EUV plasma sources (Sn, Xe, Li, …)
- Mo/Si multilayers reflect the radiation



- The absorption depth of ~ 60 nm radiation is shorter than for EUV radiation in relevant materials
  - This leads to higher secondary electron emission for OOB radiation – and may contribute to increased rate of optics contamination
  - This leads to higher direct photoabsorption in the carbon containing molecules – and may contribute to increased rate of optics contamination

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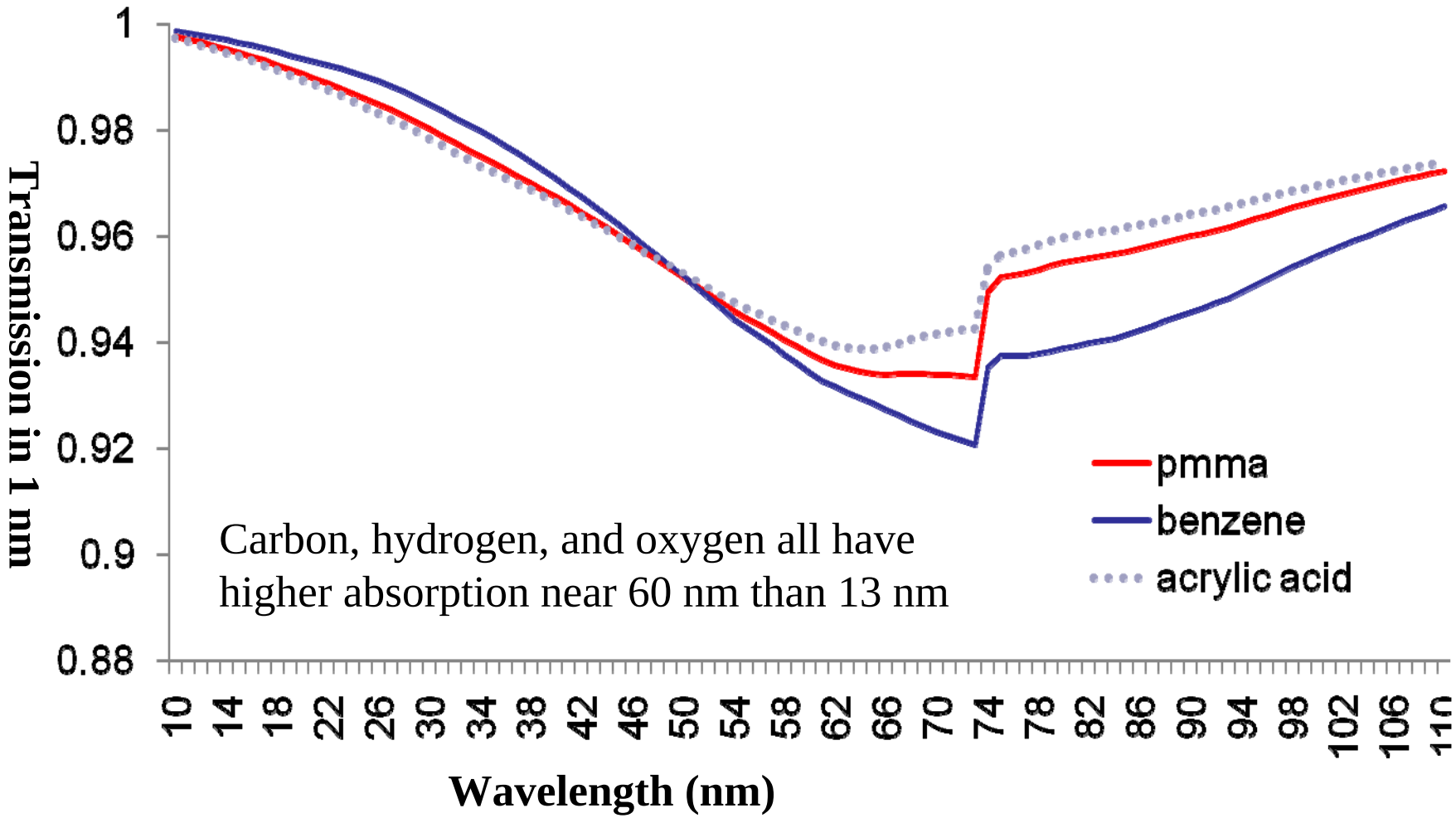
Absorption of typical species



Carbon, hydrogen, and oxygen all have higher absorption near 60 nm than 13 nm

From www.cxro.lbl.gov

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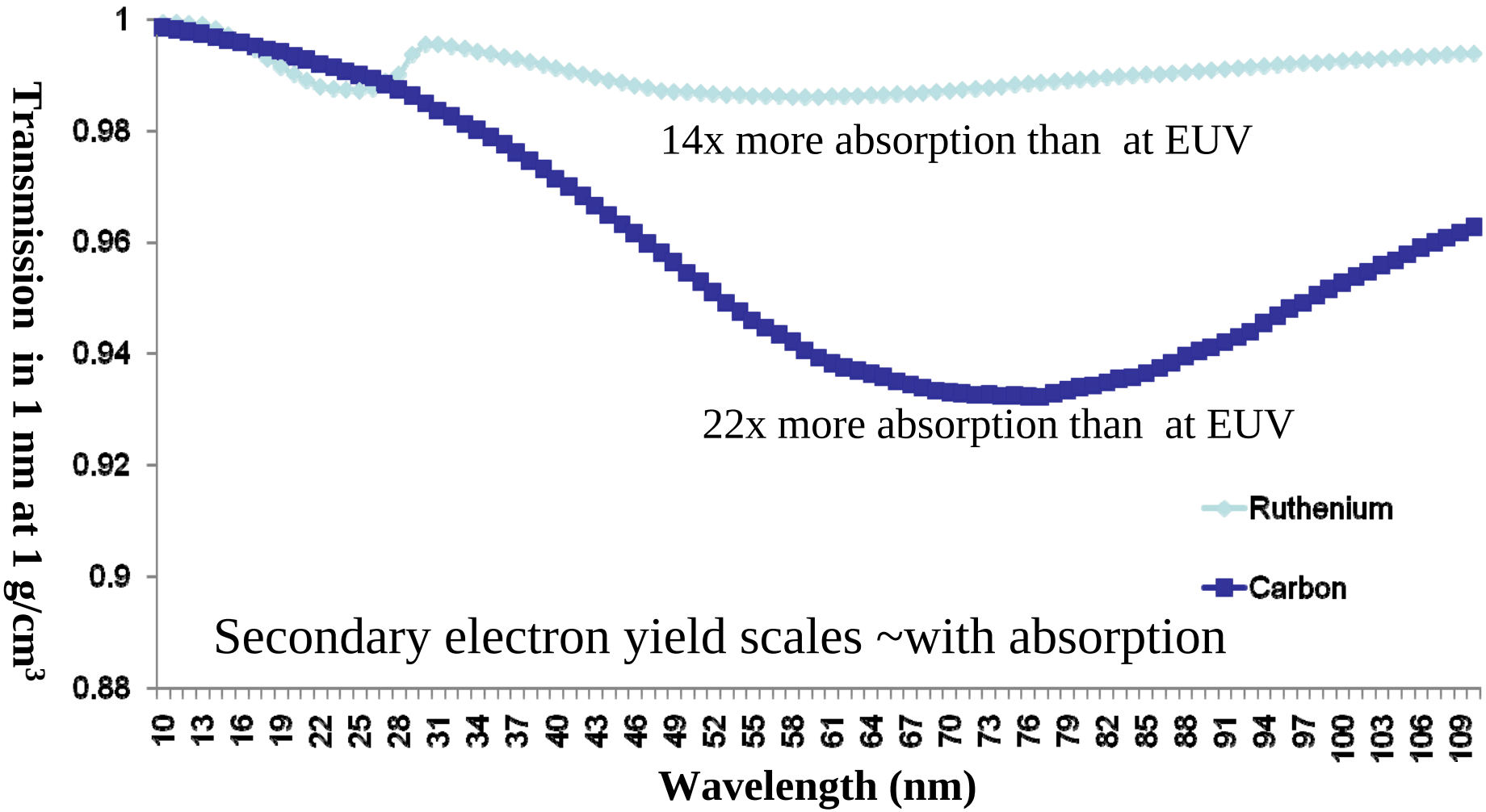
Absorption of cap layer or contamination



Secondary electron yield scales ~with absorption

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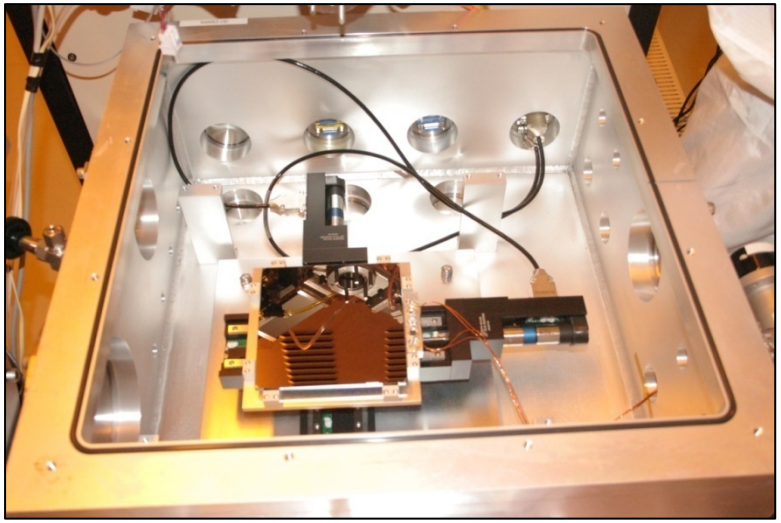
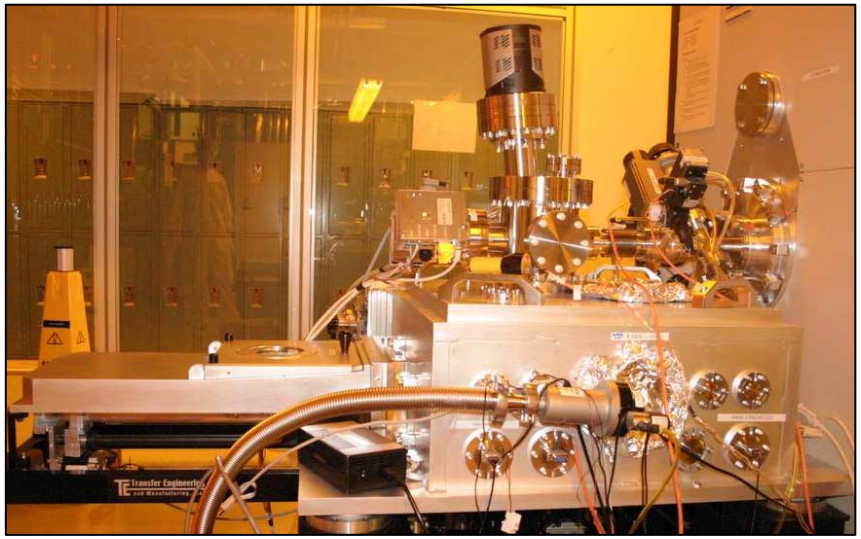
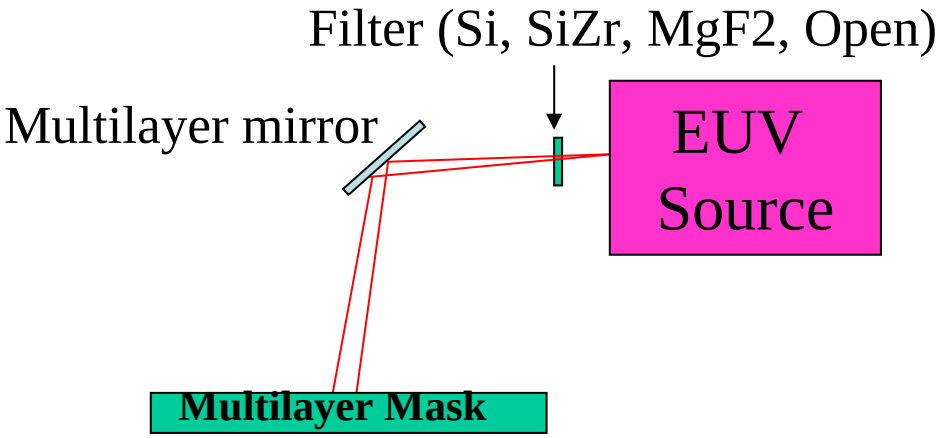
EUV MiMICS







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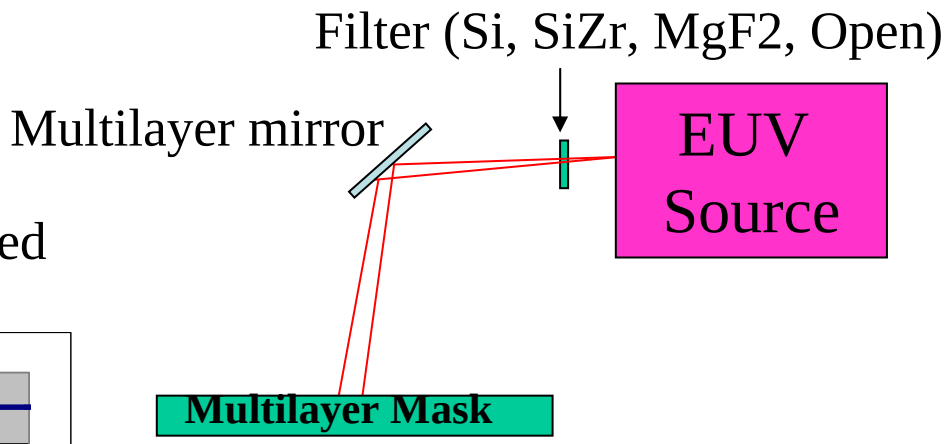
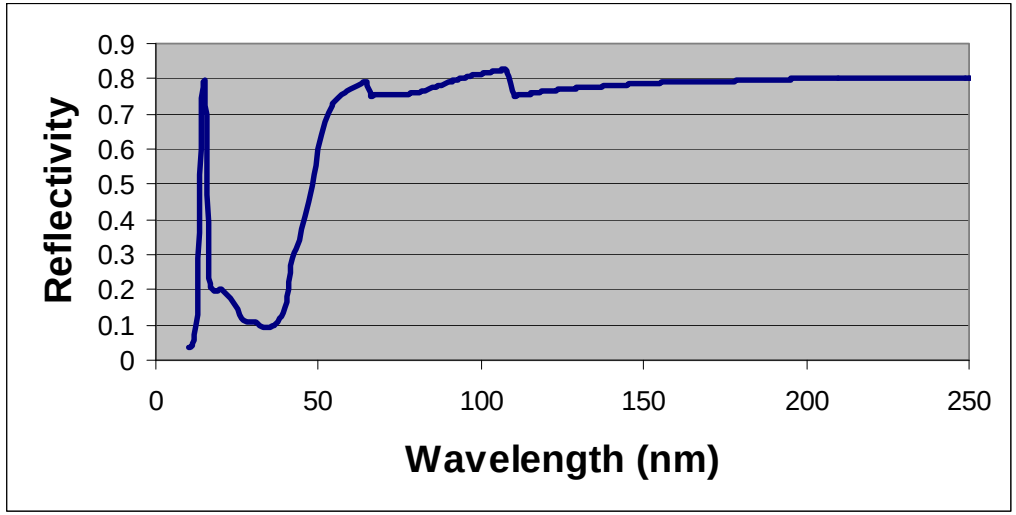
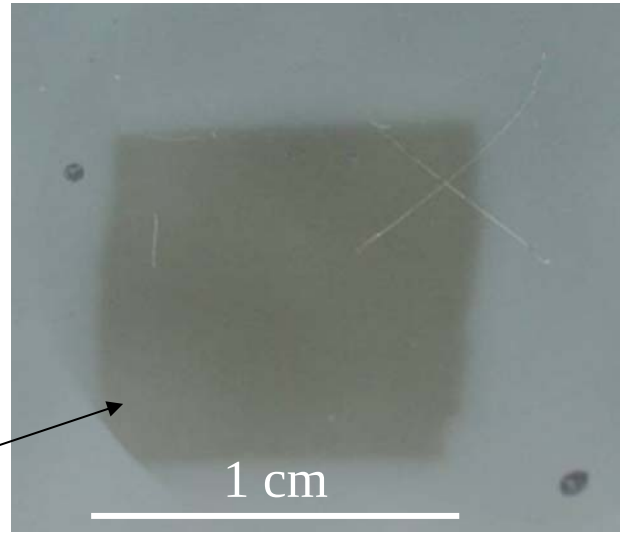
Removing the filter caused rapid contamination!



All tests shown will be for a mask illuminated after reflection from a Mo/Si mirror





Rapid contamination from exposure without a filter
Photo of carbon contamination on mask

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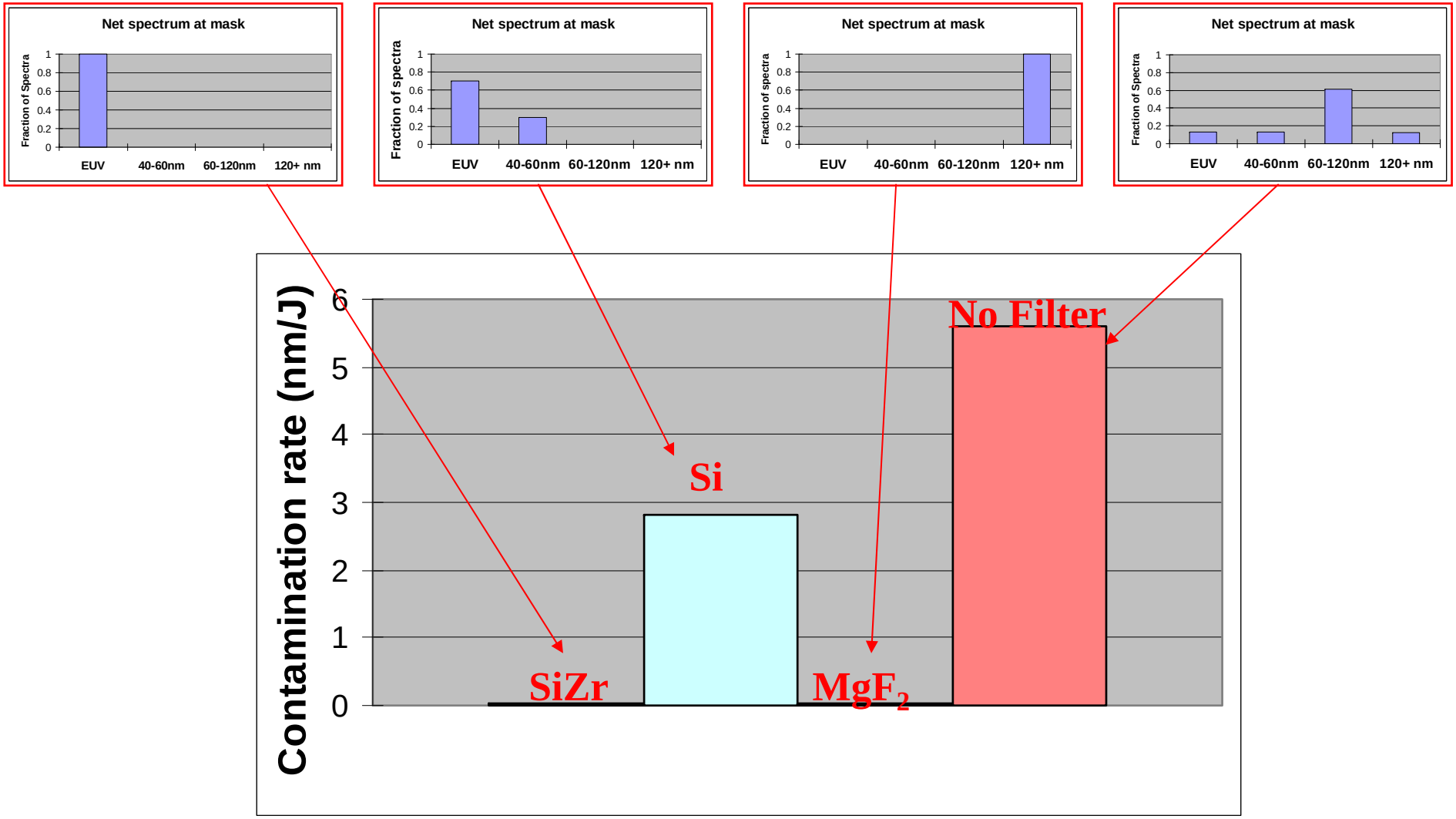
Contamination rate per Joule of exposure



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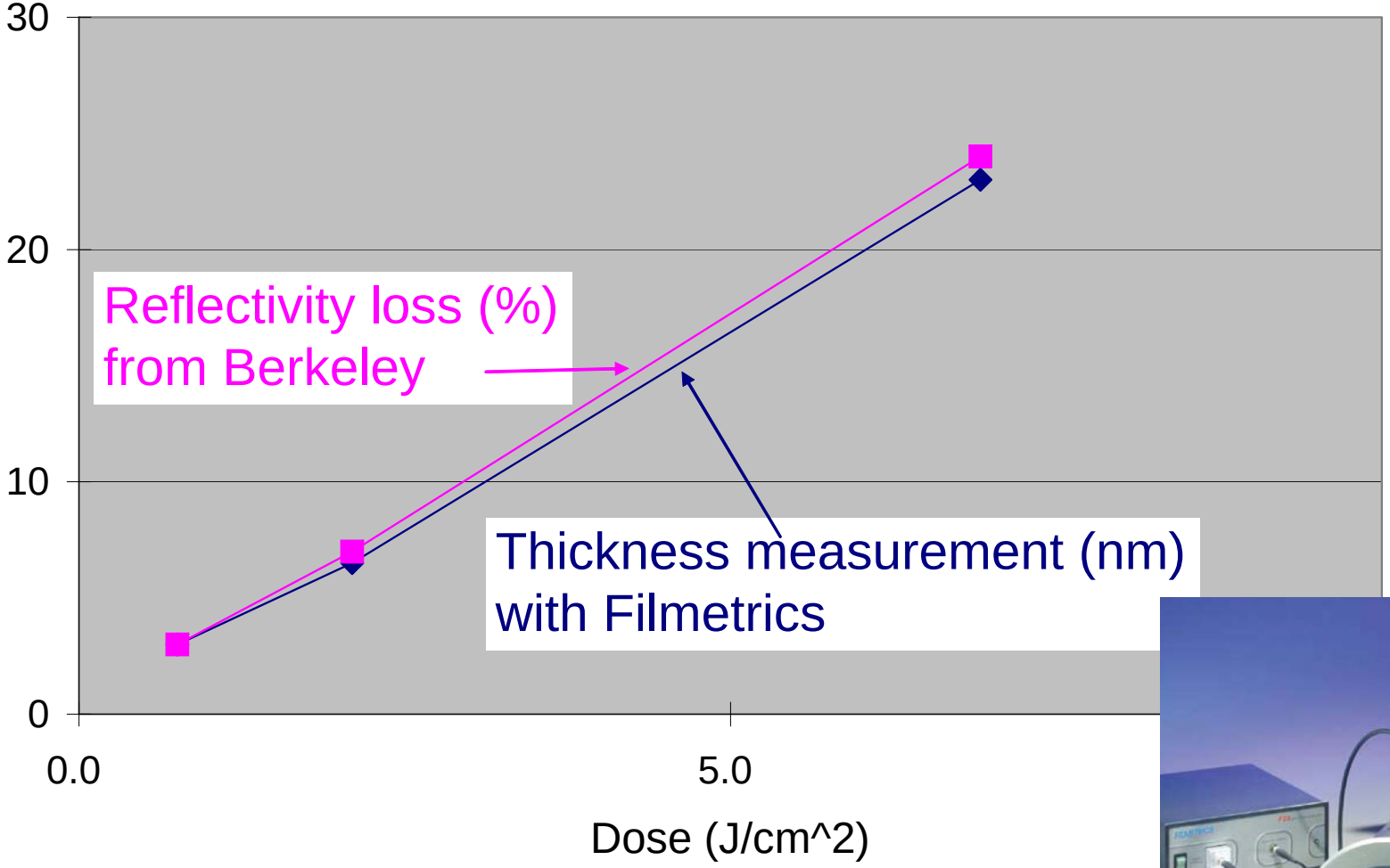
Contamination is linear with dose



There is enough contamination that it can be measured with a broadband reflectance tool

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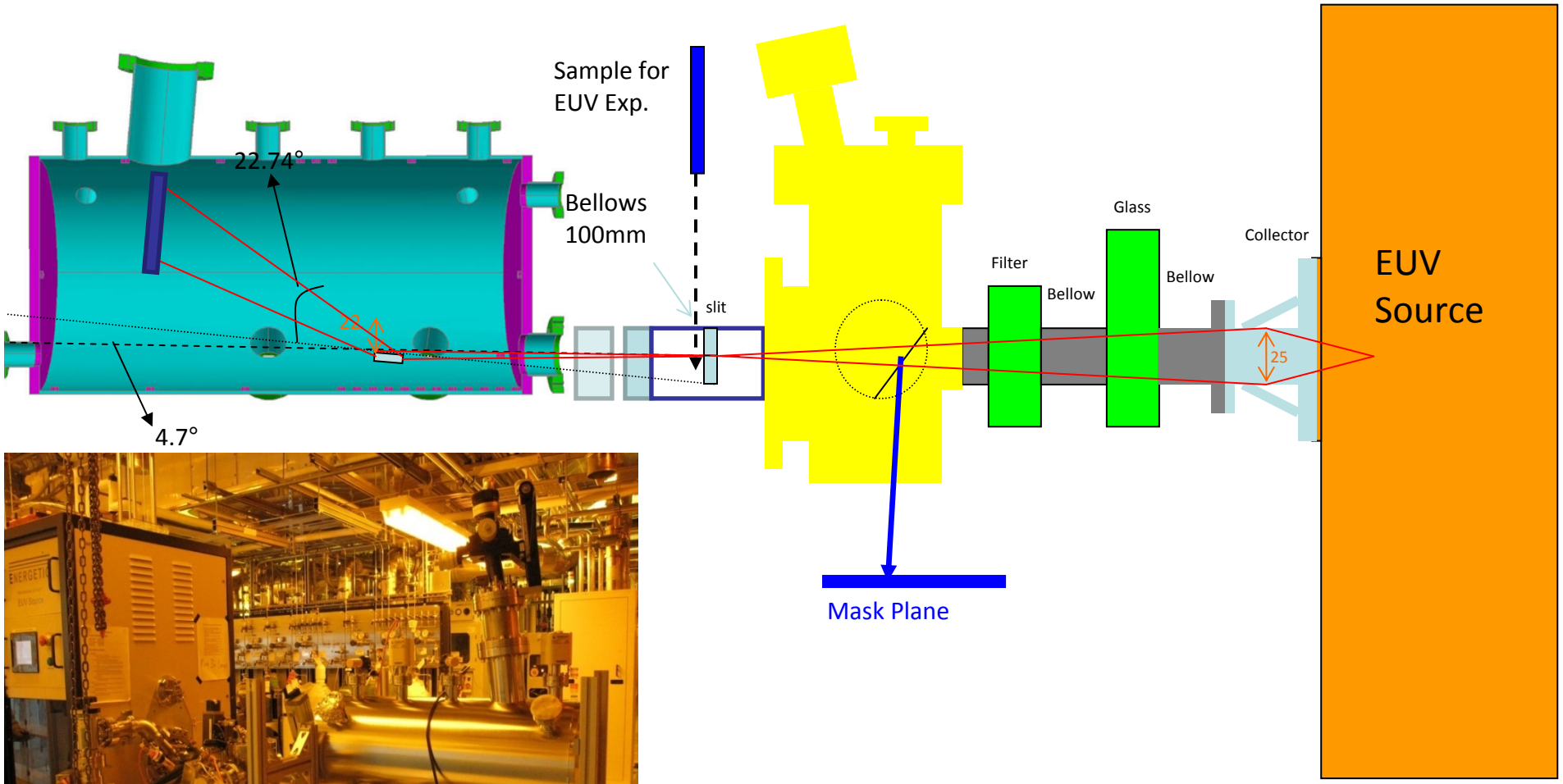

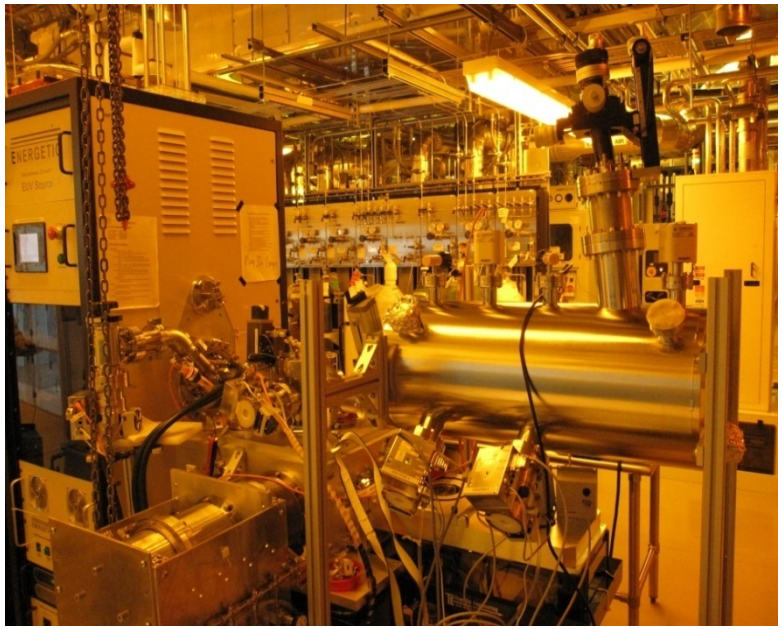

Redesigned system with custom flat field spectrometer for 22-124 nm

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