Prompt Neutron Activation Analysis (PGNAA)

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Introduction

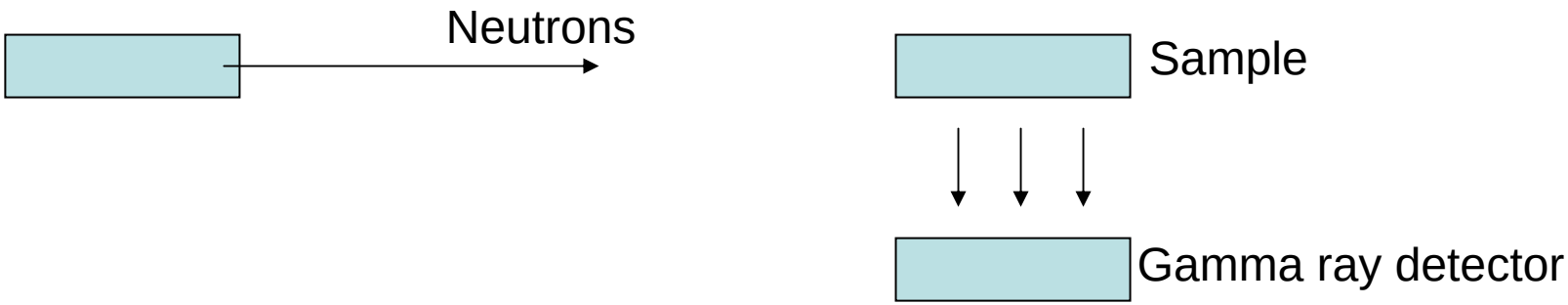
- PGNAA is a technique useful for trace elements that may not be well detected by NAA.
  - Long or short half lives, stable nuclei, weak gamma ray signals.

Principles

- Prompt neutrons are emitted immediately after neutron absorption.
- Large neutron absorption cross section is required.
- See figure and text at http://www.missouri.edu/~glascock/naa_over.htm

Instrumentation

- Must measure the gamma rays during the irradiation process
- Secondary gamma ray sources must be shielded or otherwise considered
  - Reactor produces gamma rays that must be shielded



Instrumentation

- Shielding is used for reactor gamma rays.
- Coincidence counters may be implemented
  - Coincidence counting relies on interpreting the timing and spatial properties of a series of gamma ray reactions to establish the origin of the gamma ray origin (within or outside of the sample material).
  - Impurities in shielding material (e.g. water)

Applications

- Detection of trace elements with very short or long half lives.
  - Detection of elements with stable nuclei.
- Disadvantages: complicated detector geometry and signal interpretation.
  - Access to hardware and shielding.

Applications

- Water on Mars by prompt gamma ray radiation
- See Maps of Subsurface Hydrogen from the High Energy Neutron Detector, Mars Odyssey Science, Vol 297, Issue 5578, 78-81, 5 July 2002

References

- Principles of Activation Analysis, P. Kruger (1971).
- Nuclear and Radiochemistry, Friedlander, G., Kennedy J. W., and Miller, J. M. (1964).
- Maps of Subsurface Hydrogen from the High Energy Neutron Detector, Mars Odyssey Science, Vol 297, Issue 5578, 78-81, 5 July 2002
- Website:http://www.missouri.edu/~glascock/naa_over.htm