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Recent Experimental Progress on Surrogate Reactions[1]

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Reactions on unstable nuclei are important in a wide variety of nuclear physics scenarios. Cross sections for neutron (or light charged particle) induced reactions on target nuclei spanning the chart of the nuclei are important for nuclear astrophysics (r-process, s-process rp- and p-processes etc.), for nuclear energy generation and for national security applications. Many such reactions occur on short-lived unstable nuclei. Even with the present generation of radioactive beam facilities, many such reactions are difficult, if not impossible, to measure directly. For these reactions, often the surrogate reaction technique provides the only option to provide some experimental guidance for the calculations. The experimental and theoretical techniques required are described in some detail in the recent review article by Escher et al. [1]. Originally introduced in the 1970's [2,3] the last decade has seen a resurgence of interest in the surrogate technique [1]. Various ratio techniques, external, internal and hybrid, have been developed to minimize the effect of target contamination. In the actinide region, a large number of surrogate (n,f) cross sections have been measured. In general, these show agreement to within 5-10%, with directly measured (n,f) data where these data exist (benchmarking), for equivalent neutron energies ranging from $\sim$ 100 keV up to tens of MeV. For (n,γ) reactions, measurements have been attempted for select nuclei in various mass regions (A $\sim$ 90, 150 and 235) and for these the agreement with directly measured data is less good. The various experimental techniques employed will be described as well as the current state of the experimental data. Some future directions will be described.

[1] J.E. Escher et al., Reviews of Modern Physics 84, 353, (2012) and references therein.
[2] J.D. Cramer and H.C. Britt, Nucl. Sci. Eng. 41, 177 (1970) and Phys. Rev. C 2, 2350 (1970).
[3] H.C. Britt and J.B. Wilhelmy Nucl. Sci. Eng. 72, 222, (1979).

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