A Hypothesis of Kinetics and Dynamic Control of Nuclear Reactions in Solids

#Luciano Ondir Freire [1], Delvonei Alves de Andrade [1]
[1] Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP), Brazil
E-mail: luciano.ondir@gmail.com Corresponding Author's address

Several authors suggested that background noise could influence nuclear reactions in solids, resulting in neutrons or excess heat. Literature shows that repeatability is improving, but the control over the intensity remains out of reach. This work aims at identifying possible causes for intensity variations and proposing solutions to improve controllability. The first step is to search in literature the characteristics of nuclear reactions in solids: input, output, controlling factors and enabling means. The second step is, from solid experimental facts, draw solid conclusions. The third step is developing some assumptions about the phenomenon. For each controlling factor, verify the feasibility of implementation in a heat exchanger with high surface over volume ratio. Finally, present some alternatives of architectures to improve reactions intensity control. A solid conclusion is hot spots come from aneutronic nuclear chain reactions, meaning each energetic charged particle causes the appearance of more than one new charged particle (effective multiplication factor $k_{eff}>1$). Another conclusion is background neutron radiation starts chain reactions and it causes excess heat intensity variations. An assumption is a local $k_{eff}>1$ causes micro explosions terminating the localized reactions because heat propagates faster than the particle population, resulting in low average k_{eff}. Therefore, nanoparticles or working temperatures near melting point reduce local k_{eff} allowing slow enhancement of particle population up to a level proportional to the background neutrons. A suggestion is to shield the reactors using moderators with neutron absorbers to avoid undesirable power excursions and add a voltage-controlled neutron source to control the excess heat because of the penetrating nature of neutron radiation. Magnetic or electric fields could also help the enhancement of excess heat.