Nano-sized graphene material development for neutron intensity enhancement below cold neutrons

Makoto Teshigawara[1]
Yujiro Ikeda[2], Kazuo Muramatsu[3], Koichi Sutani[3], Masafumi Fukuzumi[4], Yohei Noda[5], Satoshi Koizumi[5], Koichi Saruta[1] and Yoshie Otake[3]
[1]*Japan Atomic Energy Agency, Tokai-mura, Ibarak, Japan*
[2]*RIKEN, Wako, Saitama, Japan*
[3]*INCUBATION ALLIANCE INC., Kobe, Hyogo, Japan*
[4]*Hyogo Prefectural Institute of Technology, Kobe, Hyogo, Japan*
[5]*Ibaraki University, Tokai-mura, Ibaraki, Japan*
teshi@post.j-parc.jp

Abstract
Slow neutrons, such as cold neutrons, are important non-destructive probes not only for basic physics but also for the structural genomics advancements in the life sciences and the battery technology advancements needed for the transition to a hydrogen society. Neutron-based science is also known as high-neutron-intensity-dependent science. In generally, cold neutrons are generated by cooling neutrons produced by nuclear reactions, such as spallation reactions based on accelerators, and fission reactions in nuclear reactors. However, it is not easy to produce slow neutrons, such as ultra-cold neutrons or very-cold neutrons, below thermal equilibrium using cooling method. A new unique method focusing on nanosized particle aggregation has been proposed to increase neutron intensity in that energy region [1]. The method is based on intensity enhancement by multiple coherent scatterings with nanosized particle aggregation. The aggregation of nanosized particles matches the wavelength of below cold neutrons, causing a similar effect to coherent scattering, so-called Bragg scattering, leading to neutron intensity enhancement by several orders of magnitude. Nanodiamonds [2–4] and magnesium hydride [5] have recently been studied numerically and experimentally. The major challenge with nanodiamonds in practical applications is the molding method.
Another carbon structure, graphene is focused on to find a solution to this problem.
It is hypothesized that nanosized graphene could aid coherent neutron scattering under particle size conditions similar to nanodiamonds. Moreover, it might be possible to use it in high neutron radiation conditions due to graphene's strong sp2 bonds.
In this paper, we report the potential of nanosized graphene as a reflector material below cold neutrons, together with experimental results.

References

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