MAR13-2012-020125

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Observation of ^{239}Pu NMR in PuO_{2-}A new frontier for the physics and chemistry of plutonium compounds[1]

YASUOKA HIROSHI, Los Alamos National Laboratory

In actinide science, in general, NMR studies have been forced to limit their scope to nuclei associated with ligand atoms. The only exception of direct observation of NMR in actinide nuclei is that of ^{235}U NMR in UO_2. There have been extensive efforts to realize NMR in actinide compounds since the electronic properties of these materials are predominantly governed by the actinide atom itself. We report the first observation of Nuclear Magnetic Resonance (NMR) on the ^{239}Pu nucleus in any material. Our ^{239}Pu NMR measurements were performed on plutonium dioxide, PuO_2, for a wide range of external magnetic field values (Ho=3$\sim$8T) at a temperature of T=4K. By mapping the external field dependence of the measured resonance frequency, we determined the nuclear gyromagnetic ratio to be $^{239}\gamma_n(PuO_2)$ =2.856 $\pm$ .001 MHz/T. Assuming a free ion value for the Pu^{4+} hyperfine coupling constant, we estimated a bare value of $^{239}\gamma_n$ =2.29MHz/T for the ^{239}Pu nucleus, hence a nuclear magnetic moment of $\mu_n = .15\mu_N$ (where μ_N is the nuclear magneton). Our findings put an end to a fifty-year long search for Pu NMR and open potentially a new horizon for the solid state physics, nuclear materials science and complex chemistry in Pu compounds.

Work done in collaboration with G. Koutroulakis, S. Richmond, K. Veirs, E. D. Bauer, J. D. Thompson, G. Jarvinen, and D. L. Clark, Los Alamos National Laboratory, Los Alamos, NM.

[1]This work was supported by the Chemical Sciences, Geosciences, and Biosciences Division and by the Materials Sciences and Engineering Division, Office of Basic Energy Sciences, U.S. Department of Energy (DOE).