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Prompt gamma neutron activation analysis of alternative sensor materials for planetary exploration

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Prompt gamma-rays from a thermal neutron capture reaction have been used to determine the amount of hydrogen in various materials using the prompt gamma neutron activation analyses (PGNAA) facility at Missouri Research Reactor (MURR). PGNAA uses an intense neutron beam from a nuclear reactor to measure the concentration of certain elements, including Fe, Ni, B and H. In our research, we used samples of diamond powder, a stainless steel disk and construction bolts. Half of the samples in each group were treated with either a hydrogen or a nitrogen plasma in the plasma laboratory at Polytechnic University of Puerto Rico (PUPR) while the other half remained untreated as controls. A urea SRM was used as a standard while a titanium sample was repeatedly utilized for measuring the variation in neutron flux which is a density measurement of the neutrons passing though a given region of space. The measured concentration of hydrogen present will reflect the efficiency of absorption of the substrate to hydrogen generated in the plasma. We hope to develop substitute sensor materials which will be used for planetary exploration as well as other uses for hydrogen or nitrogen impregnated substrates from plasma fields.