## 1- عنوان البحث

| عنوان البحث |
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| **A Study of Neutron and Gamma-Ray Interaction Properties with Cobalt-Free Highly Chromium Maraging Steel**<br><br>**دراسة خصائص التفاعل بين كل من النيوترونات وأشعة جاما مع الفولاذ الخالي من الكوبالت والمحتوي على نسبة كبيرة من الكروم** |

## 2- البيانات الخاصة بالنشر

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## 5- ملخص البحث باللغة الإنجليزية

Researchers have focused on studying the neutron and photon interactions with matter (attenuation coefficients). This is attributed to increasing the use of radioactive sources in different fields of our daily life. The attenuation coefficient is an important parameter that characterizes the penetration and diffusion of neutrons and gamma-rays in the matter. This parameter depends on the chemical compositions of the alloy and the incident radiation energy. The absorbed and scattered radiations are related to the effective electron density and density of the material. Maraging steel represents a special class of high strength steels that differ from conventional steels in that they are hardened by a metallurgical reaction that doesn't involve carbon. The term maraging is coming from martensite age hardening of low-carbon, iron-nickel lath martensite matrix.

The standard maraging steel contains "18% Nickel, 8% Cobalt, 5% Molybdenum and 0.4% Titanium", but Nickel, Cobalt and Molybdenum are expensive elements, this keeps the steels rather expensive, preventing wider selection and application. Therefore, developing cobalt-free maraging steel with

reduced quantities of expensive elements to lower the production cost has been an important direction of maraging steels research. So, the purpose of the present work is to study the interactions of the neutron and gamma rays with the newly investigated cobalt-free maraging alloys. These alloys have high chromium (martensitic and ferritic) in which chromium concentration ranges from 2.0% to 18.0% of the weight.

To overcome this problem, titanium and chromium were used as the primary strengthening elements replacing Cobalt in steels. For enhancing toughness and improving corrosion resistance, the nickel content is reduced to about 12%.

In this respect, five cobalt-free maraging steel samples were prepared, using pilot plant induction furnace electro-slag re-melting technique (ESR). Titanium and chromium were used instead of cobalt and to overcome the problem of retained austenitic; the nickel content was reduced to about 12%. The steel samples were subjected to solution treatment (at 820˚C for 1 hour), with the aging process (at 480˚C for 2 hours).

Mass attenuation coefficients, effective electron densities, and fast neutrons removal cross-section for the five prepared alloys have been evaluated. A comparison of mass attenuation coefficients for cobalt-free, lead, carbon-steel, and high-nitrogen steel has been undertaken. The achieved results reveal the superiority of S3 cobalt- free alloy (0.045%C-13.35%Ni-2.05%Cr-4.5%Mo-0.06%Ti) than the other investigated alloys as a proper shielding material in the industrial and nuclear domain.