Ain Shams University
Faculty of Science
Physics Department

Investigation of New Stainless Steels Developed for Industrial and Nuclear Applications

Thesis

Submitted for Fulfill the Requirements of

M.Sc. Degree

In Nuclear Physics

By

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B.Sc. in Physics

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2017

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Grant date: / / 2017

بسم الله الرحمن الرحيم

"وَأَنْزَلْنَا الْحَدِيدَ فِيهِ بَأْسٌ شَدِيدٌ

وَمَنَافِعُ لِلنَّاسِ".

صدق الله العظيم

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ACKNOWLEDGEMENT

Acknowledgement

First and above all, Author bow head thanking **"Allah"** for helping and inspiring to accomplish all this work.

Author is deeply grateful to **Prof. *Samir Ushah El kameesy***, Professor of Nuclear Physics, Ain Shams University, for providing this opportunity to work under his esteemed guidance, for suggesting the work and supervising it, for useful comments and helping during the course of this work. Under his supervision I learned how to overcome many difficulties in my work. I also wish to express profound gratitude for his constant encouragement and critical discussions throughout this research program and during the preparation of this thesis.

Author would like to express his sincere gratitude to ***Prof. Mamdouh Mahmoud Eissa,*** Professor of Steel & Ferroalloys Technology (CMRDI). This work would not have been possible without his guidance, support and encouragement. For his effective supervision, helpful comments, and the extensive time he devoted to this work, providing many facilities during preparation and experimental measurements, and scientific supervision that helped to accomplish this study.

Author owes a great debt of gratitude to the completion of this work to **As. Prof / ElSayed Salama Ahmed,** Associate professor of Nuclear Physics, Ain Shams University**,** for his supervision, advice, and crucial contribution from the very early stage of this research by his fruitful discussion throughout this work. Above all and the most needed, he provided me unflinching encouragement and support in various ways.

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List of Abbreviations

Abbreviations	Description
AGR	Advanced gas-cooled reactor
AISI	American Iron and Steel Institute
ASME code	The American Society of Mechanical Engineers
BCC	Body center cubic crystal structure
BCT	body-centered tetragonal
BWR	Boiling Water Reactor
Ci	Curie (Activity unit)
CMRDI	Central metallurgical research institute
Cr	Chromium
dpa	displacements per atom
F/M	Ferritic/martensitic stainless steels
GIV reactors	Fourth generation of nuclear reactors
GTAW	Gas tungsten arc welding
HPGe	The Hyper Pure Germanium detector
HVL	The half value layer
Inconel	Nickel chromium alloy
ITER	International Thermo-nuclear Experimental Reactor
keV	Kilo-electron Volt
LFR	Lead-cooled reactor
LOCA	Loss of coolant accidents
MeV	Mega-electron Volt
Mox	Mixed oxide fuel is nuclear fuel that contains more than one oxide of fissile material, usually consisting of plutonium blended with natural uranium, reprocessed uranium, or depleted uranium
MPa	Mega Pascal

MSR	Molten salt reactor
Ni-Cr stainless steel	The stainless containing nickel and chromium
ODS Alloy	Oxide dispersion strengthened alloys
PCMI	Pellet cladding mechanical interaction
PWR	Pressurized Water Reactor
RBMK	High power channel-type reactor
RPV	Reactor pressure vessel
SCWR	Super critical water cooled reactor
SFR	Sodium-cooled fast reactor
SGs	Steam Generators
SiC	Silicon carbide
SMAW	Shielded metal arc welding
SPGA	Spectrographic analysis
SS	Stainless steel
TOKAMAK	Toroidal chamber with magnetic coils
TRISO	Tristructural isotropic fuel, a type of micro fuel particle consisting of a fuel kernel composed of uranium oxide (sometimes uranium carbide) in the center, coated with four layers of three isotropic materials
VHTR	Very high temperature reactor
VV-IWS	Vacuum Vessel In-wall Shield
wt	Weight
XRD	X-ray diffraction
α - Phase	Ferritic structure in stainless steel
γ- Phase	Austenitic structure in stainless steel

List of Symbols

Symbol	***Description***
μ	Linear attenuation coefficient.
$\sigma_{Exp.}$	The experimental mass attenuation coefficients.
$\sigma_{Theo.}$	The theoretical mass attenuation coefficients.
α	Alpha particle.
K	Kelvin temperature degree.
kWm^{-1}	Kilo-Watt per meter.
E	Energy.
mm	Millimeter.
ml	Milliliter.
kV	Kilo-Volt.
kg	Kilogram.
I_o	Initial intensity of radiation (gamma rays and neutrons).
I	Intensity of radiation after passing through thickness (gamma rays and neutrons).
x	Sample thickness.
W_i	Fractional weight of the element.
ρ	Density.
$\sum_R$	Macroscopic removal cross section.