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EDITORIAL

Dear reader,

It is a great pleasure to provide you the second issue of Atom Indonesia in 2021, namely Vol. 47 No. 2 (2021). Since SCOPUS and Web of Science (WOS) indexed Atom Indonesia, the number of articles submitted to Atom Indonesia has significantly increased. To retain the quality of the publications, all articles published in Atom Indonesia have been peer reviewed by qualified editors and reviewers. In addition, the publishing process is supported by a professional administration team.

The Atom Indonesia Vol. 47 No. 2 (2021) contains ten articles discussing various aspects and applications of nuclear science and technology. The contributors of those articles are not only from various national institutions and universities, but also from international institutions.

"Texture Characterization of Duplex Stainless Steel 2205 Using Neutron Diffraction Method" was explored by T. H. Priyanto, R. Muslih, A. Insani, Bharoto, A. Ramadhani, and H. Mugirahardjo from Center for Science and Technology of Advanced Materials, National Nuclear Energy Agency (BATAN), Puspiptek Area Serpong, Tangerang Selatan, Indonesia. Duplex stainless steel (DSS) is widely used in chemical processes, petrochemical, oil & gas industries, and nuclear technology due to its excellent mechanical properties and exceptional generalized and localized corrosion resistance. In this study, the crystal structure, material phases, and texture characterization of DSS were carried out using the neutron diffraction method. The characterization results show that the duplex has two phases: α (ferrite) and γ (austenite), each with a lattice parameter 2.8736 Angstrom and 3.6076 Angstrom, respectively. The sample symmetrization method from triclinic to orthorhombic is used to analyze pole figures. The crystallite orientation in the α and γ phases have the opposite direction. The α phase has a crystallite orientation towards {110} <001> or Goss orientation, and the γ phase, crystal orientation towards {100} <001> or the cube orientation. The orientation distribution function shows that the orientation strength of ferrite is much stronger than austenite. The crystallite orientation (texture) obtained by the orientation distribution function analysis follows the crystal structure analysis.

"Evaluating the Diffusion Approximation Capability on the Integral Pressurized Water Reactor (IPWR) Core Calculation" was written by H. Ardiansyah from Department of Nuclear Engineering and Radiological Sciences, University of Michigan, United States of America under collaboration with M. R. Oktavian from School of Nuclear Engineering, Purdue University, West Lafayette, United States of America and Department of Nuclear Engineering and Engineering Physics, Faculty of Engineering, Universitas Gadjah Mada, Yogyakarta, Indonesia. Diffusion approximation is an important approximation used to model a nuclear reactor core with a quite good accuracy and less computational cost. This approximation has been used widely around the globe for various kinds of nuclear reactors. This diffusion approximation is applied in a two-step method, a method combining a high-fidelity transport code and low fidelity diffusion code. Meanwhile, innovations in the nuclear core model continue to make the nuclear reactor core safer, more robust, and smaller. The trend of creating smaller and more modular reactor core is emerging in the last ten years. These innovations will affect the core modeling system. Consequently, for smaller reactors, it is important to evaluate the capability of diffusion approximation if one wants to use a computationally cheaper method to model the reactor core. In this paper, neutron diffusion calculation for 160 MWth integral pressurized water reactor (IPWR) core was conducted using the PARCS nodal diffusion code employing the few-group spatially homogenized cross-sections generated by the Serpent Monte Carlo code. Due to its capability to model any reactor geometry in the high-resolution calculation, the results from Serpent were also used as a reference. Two important parameters are compared between PARCS and Serpent: effective neutron multiplication factor and core power distribution. For the full IPWR core model, a discrepancy of 564 pcm between PARCS and Serpent k_{eff} was observed, while the radial power distribution had a maximum error of 4.71 %. It can be said, to some extent, that the diffusion approximation can be applied to IPWR core analysis. However, further improvement is indeed required if one wants more accurate results with low computational costs.

"Estimation of Population Size and Dispersal Pattern of Sterile Male Aedes aegypti Using Mark-Release-Recapture (MRR)" was explored by R. Zulfa, S. Yuliawati, M. Martini, and R. Hestiningsih from Faculty of Public Health, Diponegoro Universiy, Tembalang, Semarang, Indonesia under collaboration with B. Ernawan from Center for Isotopes and Radiation Application, National Nuclear Energy Agency (BATAN), Jakarta Selatan, Indonesia. *Aedes aegypti* is currently emerging as a main vector of Dengue, Zika, and Chikungunya transmission. Chemical control was reported to be less effective due to the resistance of this mosquito to some types of insecticides. Therefore, another vector control is needed which is most appropriate to be used, i.e. the sterile insect technique (SIT). Information about optimum range dispersal sterile male *Aedes aegypti* for optimalization SIT program are needed. This study was designed to determine the dispersal pattern and population estimation of *Aedes aegypti* sterilized with gamma rays using mark-release-recapture (MRR) method. After the male *Aedes aegypti* (pupal stage) was irradiated with 70 Gy of gamma rays, the mosquitoes were then marked with Rhodamine-B and released into the study site. MRR experiments were carried out in Batan Indah residential area, and the *Aedes aegypti* were released in center of the site. Mosquitoes were recaptured at 28 points spread over the Batan Indah Residence for 2, 4, 6, and 8 days after release by using BG-Sentinel Traps. The result showed that the population of *Aedes aegypti* in the site was estimated to be 5.402 (1.347–14.636; CI 95 %) with the furthest spread distance was 119 meters from the release point. This study also showed that the MRR experiment can be used to estimate the population size and dispersal pattern of *Aedes aegypti* movement in a given locality. The result of present study provide better understanding for optimalization mosquito-borne disease prevention based on SIT programs.

"Priming Low-Dose Gamma Irradiation Increases Cellular Radioadaptation Response through the Induction of Hsp70 and SOD2" was written by Supriyadi from Dental Radiology Laboratory, Faculty of Dentistry, Jember University, Jember, Indonesia. Exposure to low-dose radiation has been demonstrated to stimulate increased cell protection when receiving subsequent challenge dose in what is known as radioadaptation response. Hsp70 and SOD, especially SOD2, are cytoprotectors against superoxide radicals generated by radiation exposure. This study aims to measure the expressions of Hsp70 and SOD2 in parotid salivary gland acinar cells as an indicator of radioadaptation response stimulated by low-dose gamma irradiation. The study used 24 male *Rattus norvegicus* that are divided into four groups: normal control, positive control, with 50-mGy priming irradiation, and with 100-mGy priming irradiation. The animals were immobilized without anesthetics with special tools designed especially for this study. Irradiation was carried out using a cobalt-60 (gamma ray) teletherapy unit (Philips XK-100) directed to the dorsa of the animals' heads. High-dose gamma irradiation (2 Gy) was administered 5 hours after priming irradiation. The expression of Hsp70 and SOD2 was measured through immunohistochemical technique on the parotid salivary gland acinar cells and observed using a light microscope with 1000× magnification. Data obtained was analyzed with one-way ANOVA test ($\alpha = 0.05$). The results showed that Hsp70 and SOD2 expressions in the priming irradiation groups were higher than those in control groups. The conclusion of this study: priming irradiation with low-dose gamma radiation before challenge irradiation with high-dose gamma radiation increases the radioadaptation response of salivary gland acinar cells through induction of Hsp70 and SOD2.

"Impact of Tube Voltage on Radiation Dose (CTDI) and Image Quality at Chest CT Examination" was explored by M. El Mansouri, A. Choukri, and O. K. Hakam from Ibn Tofail University, Faculty of Sciences, Department of Physics, Nuclear Physics and Techniques Team, Kenitra, Morocco under collaboration with M. Talbi from Moulay Ismail University, Faculty of Sciences, Physical Sciences and Engineering, Zitoune Meknès, Morocco. During Computed Tomography (CT) scan examinations, it is important to ensure a good diagnosis by providing the maximum information to detect pathologies and this can be done with a reduced dose. In this respect, several methods of dose reduction have been studied and evaluated. This work investigates the effect of tube voltage while varying the tube current on image quality and radiation dose at Chest CT examination. This study was conducted on HITACHI CT 16 slice Scanner using two phantoms for evaluating the dose and image quality, a PMMA phantom and a CATPHAN 500. Two tube voltages of 120 KVp and 100 KVp have been used for some variation of the tube currents (mAs) and recording the values of the measured quantities (CTDIv, spatial resolution, contrast to noise ratio CNR and noise). The scanning with 100 KVp at Chest CT examination led to a reduction in CTDIv until 45 %, an increase of noise from 17 % to 45 %, and the Spatial Resolution fell slightly (6 and 7 pl/cm)

compared to the 120 KVp. The CNR shows a slight regression from 11 to 22 % for the 120 KVp and 100 KVp. This study has shown that despite the increase in the image noise at low tube voltage 100 KVp, it is possible to reduce the radiation dose by up to 45 % without degradation of image quality at Chest CT examination. Further works will evaluate the effect of acquisition parameters in other CT examinations.

"Gamma Radiosynthesis of Colloidal Silver Nanoparticles Stabilized in ι-Carrageenan Under Atmospheric Gases: A Surface Plasmon Resonance Based Study" was explored by D. P. Perkasa, M. Y. Yunus, Y. Warastuti, and B. Abbas from Center for Isotopes and Radiation Application, National Nuclear Energy Agency (BATAN), Jakarta, Indonesia. ι-Carrageenan is a biodegradable and biocompatible biomaterial which potentially stabilizes colloidal silver nanoparticles (AgNPs). The present study explored gamma radiosynthesis of AgNPs at varied concentration of ι-carrageenan solutions. The reaction system contained 1.0 mM silver precursor from silver nitrate salt. Gamma irradiation was conducted at doses up to 20 kGy under simple condition, i.e., atmospheric gases and without addition of hydroxyl radical scavenger. The behavior of AgNPs in suspension was characterized based on their surface plasmon resonance (SPR) absorption spectra which were measured using UV-vis spectrophotometer. The results show that colloidal AgNPs were successfully radiosynthesized due to dual stabilizing/reducing activity of ι-carrageenan. The degradation product of ι-carrageenan shows antioxidant activities, which increase the reducing condition of the reaction system. TEM micrograph reveals that the nanoparticles are spheroid in shape and monodisperse with an average particle size of below 10 nm. The SPR spectra indicate that the highest AgNPs concentration is found for irradiation at a dose of 10 kGy and ι-carrageenan concentration of 1.0 % (w/v). However, instability of AgNPs occurred a day after radiosynthesis due to oxidative dissolution and agglomeration. Further works on pH adjustment and optimization on irradiation dose and ι-carrageenan concentration are critical to improve the stability of colloidal AgNPs.

"An Automated Measurement of Image Slice Thickness of Computed Tomography" was explored by S. Sofiyatun, C. Anam, and U. M. Zahro, from Department of Physics, Faculty of Sciences and Mathematics, Diponegoro University, Tembalang, Semarang, Indonesia under collaboration with D. A. Rukmana from Radiology Department, Indriati Hospital Solo Baru, Sukoharjo, Indonesia and G. Dougherty from Department of Applied Physics and Medical Imaging, California State University Channel Islands, Camarillo, USA. Measurement of the slice thickness in computed tomography (CT) is usually made using a special phantom, such as the AAPM CT performance phantom. Images of the phantom are analyzed manually and subjectively. The purpose of this study is to develop an automated system for measuring the slice thickness of the CT image of the phantom using MATLAB software. The CT AAPM performance phantom was scanned by a 128 multi-slice computed tomography scanner (Revolution Evo, GE Healthcare, Waukesha, WI) at a slice thickness of 5 mm with four different phantom orientations and also scanned by a 6 multi-slice CT scanner (Somatom Emotion 6, Siemens AG, Forchheim, Germany) for two slice thicknesses of 5 and 10 mm. Our automated method produced an accurate slice thickness value less than 0.5 mm different from the nominal slice thicknesses and manual measurements. Similar results were obtained when the phantom was rotated. This system is more objective and effective compared to manual systems.

"Addition of Lead (Pb)-Nitrate Filler on Polymer Composite Aprons for X-Ray Radiation Shielding" was written by E. Afrianti and D. Tahir from Department of Physics, Hasanuddin University, Tamalanrea, Makassar, Indonesia under collaboration with B. Y. E. B Jumpeno, O. A. Firmansyah, and J. Mellawati from Center for Technology of Radiation Safety and Metrology, National Nuclear Energy Agency (BATAN), Jakarta, Indonesia. Radiation shielding aprons are needed by radiation workers to minimize radiation exposure to the body. The aprons at present use fabric-coated lead plates, which are heavy and rigid materials and therefore are not comfortable to use. Polymer aprons from cassava starch and glycerin with addition of Pb-nitrate filler at 0 %, 2 %, 4 %, and 6 % have been synthesized. Mixtures for synthesizing the polymer apron composites were heated using a magnetic stirrer at a speed of 800 rpm at 160 °C for 25 minutes. Then, the polymer apron composites were dried in an oven for 24 hours at 70 °C. The effectiveness of the apron was determined by calculating the attenuation coefficient (μ), half-value layer (HVL), and radiation absorption. The mechanical properties of the aprons were characterized by testing their tensile strengths using an A&D MCT-2150 universal tester. The result shows that the optimal addition of Pb-nitrate filler of as much as 6 % produced aprons with an attenuation coefficient of 1248 cm^{-1}, HVL of 0.54 cm, and radiation absorption of 25 %, while the aprons' tensile strength was obtained as 28.244 MPa.

The addition of Pb-nitrate as a filler in apron composites proportionally improves the quality of materials used as radiation shields. More detailed research is still needed to obtain the best apron.

"Comparisons of Water-Equivalent Diameter Measured on Images of Abdominal Routine Computed Tomography with and without A Contrast Agent" was explored by A. Nitasari, C. Anam, W. S. Budi, and A. L. Wati from Department of Physics, Faculty of Sciences and Mathematics, Diponegoro University, Tembalang, Semarang, Indonesia under collaboration with S. Syarifudin from Department of Radiology, Dr. Kariadi Hospital, Semarang Selatan, Semarang, Indonesia and G. Dougherty from Department of Applied Physics and Medical Imaging, California State University Channel Islands, Camarillo, CA, USA. The size-specific dose estimate (SSDE) is a metric for an estimation of patient dose in computed tomography (CT). The SSDE strongly depends on the water-equivalent diameter (D_W). In abdominal CT examinations, a contrast agent is sometimes used to more clearly visualize tissue lesions. The Hounsfield unit (HU) of CT images with and without the use of a contrast agent at specific areas is slightly different and it may affect the D_W value. This study aimed to compare the D_W values calculated from axial CT images in patients who had undergone routine abdominal scans both with and without the use of a contrast agent. Axial images of 144 patients with a weight range of 3.5 kg to 90 kg who had undergone routine abdominal scans both with and without the use of a contrast agent using a Siemens Sensation 64 CT scanner were retrospectively collected. The D_W values were automatically calculated using the Matlab-based IndoseCT (version 15a) software. The results show the percentage difference between $D_{W,contrast}$ and $D_{W,non\text{-}contrast}$ is below 2 %. As a result, the mean $SSDE_{contrast}$ is 1.5 % smaller than $SSDE_{non\text{-}contrast}$. Due to the effect of a contrast agent on the D_W and SSDE values is below 2 %, the axial images of CT abdomen without the use of a contrast agent can be used as the accurate estimation of D_W and SSDE for images with the use of a contrast agent.

"Coupled Analysis of Thorium-based Fuels in the High-Performance Light Water Reactor Fuel Assembly" was explored by Y. Pérez, C. R. García, and F. L. Mena from lnstituto Superior de Tecnologías y Ciencias Aplicadas (InSTEC), Universidad de La Habana, Quinta de los Molinos, La Habana, Cuba under collaboration with L. Castro from Universidad Nacional Autónoma de México, Facultad de Ingeniería, Departamento de Sistemas Energéticos, Jiutepec, Morelos, México. One of the six selected concepts to be part of Generation IV nuclear reactors is the Supercritical Light Water Cooled Reactor. The High-Performance Light Water Reactor (HPLWR) is the European version and it is a very promising design. In recent years, interest in the study of thorium-based fuel cycles has been renewed and its possibilities for current LWRs have been evaluated. The use of thorium based fuels will be fundamental in the future sustainability of nuclear energy, since in addition to its abundance in nature, thorium has an important group of advantages. In this paper, performance of thorium-based fuels in the typical fuel assembly of the HPLWR reactor is evaluated, using a computational model based on CFD and Monte Carlo codes for the neutronic/thermal-hydraulic coupled analysis. The volumetric power density profiles, coolant temperature profiles, fuel temperature profiles and others are compared with those obtained for standard UO_2 fuel. When the thorium-based fuels are used, the obtained infinite multiplication coefficients are smaller than the value obtained when UO_2 is used, since the ^{232}Th isotope has a lower contribution to the multiplicative properties of the medium than ^{238}U. As a result, a difference of approximately 12 000 pcm was observed. The results verified that the HPLWR is a thermal reactor with a hard spectrum. There are no notable changes in the neutron spectrum if the mass fraction of thorium is slightly varied. With coupled analysis, the potential benefits of the utilization of thorium-based fuels were verified. Moreover, a significant temperature decrease by 136 K on the center line of the fuel elements was observed. When the mass fraction of thorium increases in the oxides mixture, the weighted average temperature on the fuel elements decreases.

On behalf of Atom Indonesia, I would like to thank you all for your contributions and endless support that have allowed Atom Indonesia to reach an outstanding performance for all the years. This outstanding achievement could not have been reached without great efforts and cooperation from the editors, reviewers, management personnel, authors, and readers.

Editor in Chief