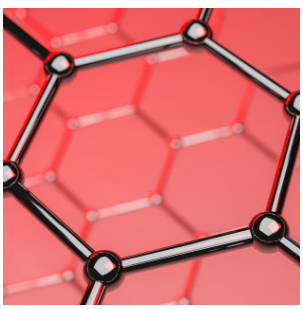
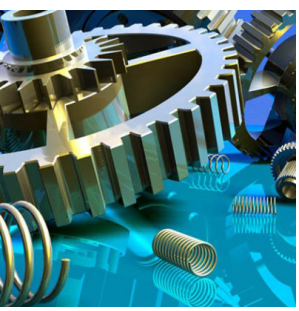
Poster Presentation

Material Science 2019





3rd International Conference on

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Synthesis of hydroxyapatite from limestone by using precipitation method

Makmur Sirait, Ratna Sari Dewi Siregar, Karya Sinulingga and **Nurdin Siregar**
Universitas Negeri Medan, Indonesia

Hydroxyapatite from limestone was synthesized by precipitation method. During the synthesization the temperature of a 200 mesh sample was increaced to 600oC for 3 hours. The heating means to transform CaCO3 into CaO. Then the CaO was dissolved in aquades to get Ca(OH)2 , then disolved in H3PO4 0,3M as sorce of phosphate. The solution was mixed using magnetic stirrer with speed of 300 rpm for 1 hours. Then NH4OH 1M are periodically drops so that the solution becomes an alkaline with pH 10. Then the solution was left for 24 hours and precipated was dried in 120oC for 5 hours. Hydroxyapatite powder obtained was characterized by FTIR to see the major functional groups that is formed in hydroxyapatite limestone. The results were 3 functional major groups that is phospate (PO43-), carbonate (CO32-) and hydroxyl (OH-) on hydroxyapatite limestone. This shows that a good hydroxyapatite has been formed.

Speaker Biography

Makmur Sirait has completed his PhD at the age of 51 years from North Sumatra University, Medan Indonesia. He is the head of physics program study FMIPA Universitas Negeri Medan, Indonesia. He has over 70 publications that have been cited over 40 times, and his publication H-index is 3 and has been serving to Ministry of Research and Higher Education of Indonesia for research funding support via DRPM funding scheme.

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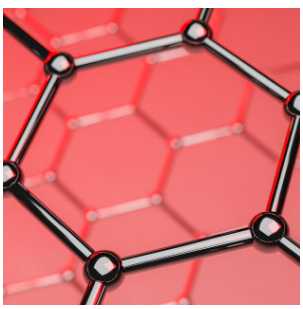

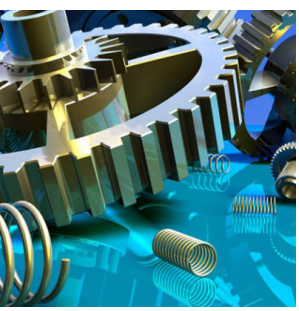

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Plasmonic nanostructures for imaging and targeting drug delivery

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Engineering a compact, near-infrared plasmonic nanostructure with integrated image-enhancing agents for combined imaging and therapy is an important nanomedical challenge. To overcome this challenge we designed a nanostructure with NIR plasmonic signatures composed of a 50 nm Au core surrounded a SiO2 inner-shell doped with contrast agents and an outer Au shell. The plasmon resonance of this nanostructure, known as a nanomatryoshka (NM), can be tuned to the desired wavelength by varying the thickness of the layers. The encapsulated contrast agents used in this study are: Fe(III)-DOTA, Gd(III)-DOTA, and fluorescent dyes. The Fe(III)-NM based contrast agents are found to have relaxivities two times greater than the widely used Gd(III)-DOTA, providing a practical alternative for T1 MRI contrast agent that eliminates Gd(III) patient exposure entirely. Additionally, the internalization of fluorescent dyes and MRI contrast imaging agents within the NM substantially reduces the toxicity while maintaining a free nanoparticles surface for further bio-functionalization.

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Process intensification techniques for the production of nano and submicronic particles at industrial scale

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Nowadays, nanoparticles are of great interest for the industry due to their numerous possible applications in several fields. Research on this topic seeks to develop many procedures to produce nanoparticles, mostly at lab scale, batch-wise and with low yield. These procedures generally do not suit industrial needs of continuous, high capacity production. Moreover, the product characteristics require targeting narrow particle size distributions and high quality, which is difficult to achieve by traditional equipment. Process intensification techniques aim to minimize plant size of continuous, high yield equipment capable to produce specific sized, high quality nanoparticles, combined with an increase in energy efficiency, safety and cost reduction.

This paper reviews some adopted Process Intensification (PI) techniques for nanoparticles synthesis processes employed in the food and pharmaceutical sector. By reducing the technology transfer gap, nanotechnologies may become convenient and feasible, allowing both industries to achieve the production of higher quality products with particular characteristics without sensibly increasing additional costs. This will represent in the next future a strategic key feature of industries in the global market.

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Photothermal materials for onsite water harvesting from unconventional sources

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The accelerated increase in freshwater demand highlights the urgency in creating alternative water sources to meet the ever-increasing need for increased water supply. This is particularly critical for populations displaced in remote locations where conventional water sources and the infrastructure required to produce potable water may be intermittently or completely absent. Therefore, infrastructure-independent water technologies that are low-cost, robust with simple operations are sought. In this presentation, we highlight a standalone 3D photothermal foam that can be used to generate potable water from seawater and atmospheric moisture via interfacial solar evaporation. Specifically, the foam showed a remarkable specific evaporation rate of 11.4 kg m-2 h-1 g-1 with an energy efficiency of 92.7%. Due to the presence of hydrophilic domains within the foam, they can also be employed to capture and store water (both liquid and vapor) that can then be harvested via solar evaporation; the average amount of absorbed water vapor and liquid water harvested for each cycle were 250-1770 mg H2O per g of dry foam. The high evaporation efficiency combined with the versatility of the foam in harvesting water from varying sources enable them to produce potable water under circumstances where there is a high level of uncertainty associated with the availability and quality of water such as in the aftermath of a disaster. Considering the lightweight of the foam (bulk density of 0.2 g cm-3), they could offer a simple solution that can be rapidly deployed to produce potable water for short-term sustenance in acute emergencies.

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Innovative silicon-based PV technologies to reduce electricity production costs

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The costs per watt of the solar cell has dropped so fast that the module manufacturing is a small fraction of the total costs, and the balance of system cost, or commodity materials, drive the cost of producing solar energy. Because of the cost structure, increasing efficiency and average energy generation are Today the most powerful levers for overall cost reduction.

Silicon Heterojunction (HJT) is an innovation in PV, which can win the competition with mainstream technologies based on consolidated diffusion processes in silicon. In fact, by leveraging on high efficiency, high thermal stability, lower degradation per year and high bifacial factor, HJT can lead to a remarkable reduction of the levelized cost of energy (LCOE) in €/kWh. The fabrication process of HJT is simpler and makes it the most performing technology based on silicon, relying on its compatibility with several advances that will allow the solar cell to overcome the theoretical limits of silicon, aiming at achieving more than 30% cell efficiency. In particular, multi-junction solar cells are the most promising path to increase PV module performances, several approaches are explored to find a tandem structure, which can be industrialized. Coupling with an HJT bottom cell seems a viable path to obtain an industrial application. We report on the efforts for the development and industrialization of innovative Si heterojunction technology towards more than 25% efficiency, as well as on the activities to overcome the theoretical limits of silicon, aiming at more than 28%, through implementation of multiple junction structures.

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Impacts of entropic separation effects

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One of the fundamental challenges of our time is to mitigate the effects of climate change and to strive for a responsible handling of resources and raw materials. In order to reach those goals, industrial processes need to be altered as well. This development must, among other things, aim to replace unsustainable by eco-friendly methods. One such example would be the replacement of unsustainable processes like distillation to separate hydrocarbons by adsorption methods. Due to their high surface-to-volume ratio and the wide range of possibilities to design and modify the pore environment, metal-organic frameworks are appropriate candidates to conduct highly efficient adsorption processes to separate hydrocarbons. However, for a broad industrial application, comprehensive knowledge of separation effects and the behaviour of guest molecules within the channels of metal-organic frameworks is needed.

Besides the well-known separation mechanisms, based on enthalpic, kinetic or steric (i.e., sieving) differences, there is a further mechanism based on entropic effects, which seems to be virtually unknown and is, hence, often ignored. Those entropic effects describe the efficiency with which guest molecules can arrange themselves inside the channels of nanoporous materials. Due to the remarkable selectivities that can be reached through entropic separations, they are of particular interest. The aim of this presentation is to give a short outline of entropic separation effects and to present individual results of the entropic separation of hydrocarbons obtained by Monte Carlo simulations.

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Electromagnetic excitations in a non-ideal microcavity lattice

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The advent of optoelectronic devices utilizing various recent advances in photonics such as the harvesting of light by nanophotonic waveguides or quantum information processing has elevated the importance of the correct theoretical understanding of nanocrystalline photonic structures. A special class of photonic crystals featured by a strong coupling between quantum excitations (excitons) and optical fields is called polaritonic crystals. Examples of polaritonic structures are spatially periodic systems of coupled microcavities (resonators) as well as by the arrays of quantum dots embedded within photonic nanostructures. Lately, there has been a growing interest for optical modes in microcavity arrays with embedded quantum dots. Basing on our previously developed concepts of non-ideal polaritonic structures in the present work we study the effect of random uneven spacing of cavities on the dispersion characteristics of electromagnetic excitations in 1D and 2D microcavity lattices. More specifically, we consider the case of polaritonic excitations in a non-ideal two-sublattice tunnel-coupled microcavity system with embedded quantum dots as well as the case of exciton-like excitations in the system of quantum-dot-free cavities. Our results contribute to the modeling of the new class of functional materials, namely the so-called polaritonic systems (microcavity arrays with embedded quantum dots) where controlling of propagation of electromagnetic excitations is accomplished by an appropriate introduction of structural defects.

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Formative biofabrication using levitational bioassembly in high magnetic field

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Several research groups recently demonstrated the principal feasibility of magnetic levitational bio-assembly of tissue engineered constructs from living tissue spheroids in the presence of paramagnetic ions. However, Gd3+ is relatively toxic at concentrations above 50 mM used normally to enable magnetic levitation with NdFeB permanent magnets. Using high magnetic field at HFML in Nijmegen, the Netherlands, it was possible to perform magnetic levitational assembly of tissue constructs from living spheroids prepared from SW1353 osteosarcoma cell line with 100 times lower concentration of Gd3+. The assembly of tissue constructs was performed in a 50mm-bore, 30 Tesla Bitter magnet, equipped with mounting for cuvettes filled with culture medium containing spheroids and non-toxic concentrations of Gd3+. The levitation conditions were initially adjusted using 170 µm polystyrene beads. To predict the theoretical possibility of assembly, a zone of stable levitation in the horizontal and vertical area of cross sections was previously calculated. Round-shaped structures from the polystyrene beads and tissue spheroids were assembled at 0.5 and 0.8 mM Gd3+ in 22T and 19T magnetic fields, respectively. The construct from tissue spheroids partially fused after 3 hours of levitation. The analysis of viability after prolonged exposure of strong magnetic field showed the absence of significant cytotoxicity or morphology changes in the tissue spheroids. High magnetic fields works as a temporal and removal support or so-called “scaffield”. Thus, formative bio-fabrication of tissue engineered constructs from tissue spheroids in high magnetic field is a promising research direction.

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A method for obtaining nano-sized structures in bulk materials with polymorphic metallic matrixes

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There are some methods to form nanostructures in metal-based materials the common feature of which is their applicability for obtaining only thin films or surface layers. A novel method to provide nano-sized structures in bulk alloys, composites, sintered and 3-D printed materials with polymorphic metallic matrixes was proposed and applied to industrial cast irons and alloy structural steels. The method is based on optimal isothermal holding during cooling or heating of a product unlimited form and size after or before its austenitizing. Mathematical relations between the optimal holding temperatures and durations providing targeted grain sizes were derived. Over threefold increase in the impact resistance for the cast irons and steels was reached. The above performance improvements are accompanied by the materials chemical and structural homogenizing. Necessity of the phenomena revealed detail investigations is emphasized and prospects of the method further employments are discussed.

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An analytic modeling the air-mist cooling for continuous cast slabs

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Despite the extensive use of the air-mist secondary cooling (SC) the continuous cast slabs (CCS) some drawbacks of the existing control models are still unrepaired:- big amount of online numeric calculations to specify the real-time values of the SC characteristics: slab temperature profile, water flow rate, heat transfer coefficient etc.; - fully empirical nature of the currently applied necessary relations between the corresponding technological parameters; - possibility of nonlinear phenomena or processes development during the SC that leads to violations of the "additivity" rule and decreases accuracy of the control. Aim of the research is to show possibility to improve the steel slab caster productivity, SC control effectiveness and finished slab quality by application of early developed model for the air-mist cooling, based on meeting the "mixture" rule requirements. A new "one-equation" approach is developed to determine the air-mist cooling characteristics analytically. It utilizes the main equation that provides defining the air-mist supply conditions to avoid the nonlinear phenomena appearance during the cooling. The equation is also adjusted to take into account the heat transfer and related processes development. Cooling time or secondary cooling zone length analytical distributions are obtained for basic SC characteristics. Function relations between the relevant technology parameters are also derived. High stability of the main secondary cooling characteristics under the typical casting speed fluctuations is shown. The approach provides improving the cooling control effectiveness due to decreasing the on-line calculation amount in comparing with currently applied numerical on-line solving the systems of differential equations. Improvements of the caster productivity and finished slab quality are grounded to obtain

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Science of biomaterials and surgical techniques for enhanced tissue regeneration in implant dentistry

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The use of dental implants for the rehabilitation of missing teeth provide optimal masticatory function and esthetics, improving self-esteem and overall quality of patient's life. The recent achievements in the fields of nanotechnology and biomaterial engineering gave new perspective on regeneration and therapeutic success in dental implantology. Modifications of implant design and materials at a nanoscale, along with delivery of biomaterials which could enhance osseointegration and bone regeneration, contribute greatly to implant treatment success. However, the therapeutic challenges associated with the patient with limited regenerative potential of the surronding tissue, due to systemic health problems such as immunological disorders or diabetes mellitus, require additional compounds and surgical procedures to achieve successful implant treatment. In that context, the aims are to point at biological aspects related to the beneficial regenerative properties of biomaterials used in bone grafting as well as of piezosurgery in healthy and in patients with diabetes mellitus. Evaluation of biologic characteristics aims to provide insight into proper and optimal use of biomaterials for long term successful implant treatment.

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Raman spectroscopy of CVD graphene during the transfer process from copper to SiO2/Si substrates

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Raman spectrum of CVD graphene was monitored during the transfer process, from the growing copper substrate to the final silicon substrate, passing through different liquids used to dissolve copper and to clean the resulting carbon film. The position of G and 2D peaks shifted when graphene was on the surface of different liquids. The largest Raman shift occurred for ferric nitrate and nitric acid solutions; this result shows that these solutions induced the p-type character of CVD graphene. The critical finding is that the situation of graphene (strain and doping) deposited via a CVD method changes when it is translated from the original to the final substrate.

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Effect of feed supplementation with biosynthesized silver nanoparticles using leaf extract of *Morus indica* L. V1 on *Bombyx mori* L.

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Herein, we report the synthesis of silver nanoparticles (AgNPs) by a green route using the aqueous leaf extract of *Morus indica* L. V1. The synthesized AgNPs exhibited maximum UV-Vis absorbance at 460 nm due to surface plasmon resonance. The average diameter (~54 nm) of AgNPs was measured from HR-TEM analysis. EDX spectra also supported the formation of AgNPs, and negative zeta potential value (-14 mV) suggested its stability. Moreover, a shift in the carbonyl stretching (from 1639 cm-1 to 1630 cm-1) was noted in the FT-IR spectra of leaf extract after AgNPs synthesis which confirm the role of natural products present in leaves for the conversion of silver ions to AgNPs. The four bright circular rings (111), (200), (220) and (311) observed in the selected area electron diffraction pattern are the characteristic reflections of face centered cubic crystalline silver. LC-MS/MS study revealed the presence of phytochemicals in the leaf extract which are responsible for the reduction of silver ions. MTT assay was performed to investigate the cytotoxicity of AgNPs against two human cell lines, namely HepG2 and WRL-68. The antibacterial study revealed that MIC value of the synthesized AgNPs was 80 µg/ml against *Escherichia coli* K12 and *Staphylococcus aureus* (MTCC 96). Finally, the synthesized AgNPs at 10 µg/ml dosages showed beneficial effects on the survivability, body weights of the Bombyx mori L. larvae, pupae, cocoons and shells weights via enhancing the feed efficacy.

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