Kabarak University International Conference On The Basic Sciences - 2021

Tuesday 12 October 2021 - Wednesday 13 October 2021

Book of Abstracts

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FUNGICIDE USE IN HORTICULTURE LINKED TO ANTIFUNGAL RESISTANT ASPERGILLUS SPECIES IN KAJIADO COUNTY, KENYA.
Abstract
Pesticides use in agriculture has been associated with antifungal resistance in clinical practice. Azole-resistant A. fumigatus isolates have been reported in some countries ascribed to either previous antifungal treatment, prophylaxis or fungicides use in agriculture. The use of azole-based fungicides in robust horticulture in Kenya is a risk factor for antifungal resistance. The study analyzed environmental isolates of Aspergillus fumigatus, Aspergillus flavus and Aspergillus niger for the presence of resistance against the triazoles antifungal (Itraconazole (ITZ), voriconazole (VCZ) and posaconazole (PCZ). Cross-sectional study design was used. Dry top surface soils were sampled from the study site. Each soil sample was processed and approximately 100µl of the preparations plated onto SDA containing no drug, 1µl/ml itraconazole and 1µl voriconazole. Aspergillus species were identified by MALDI TOF MS and ITS genes amplification. Absence or presence of TR34 in the promoter region was determined by A. fumigatus DNA amplification using AFCYPPR and AFCYPPF primers. While L98H the mutation was determined by amplification of isolates DNA using AFCYP98R and AFCYP98F primers. Gel electrophoresis was run to detect DNA amplicon. A total of 250 Aspergillus spp were isolated of which, 7.2% were resistant to either of the three azoles antifungal (Itraconazole, Voriconazole and Posaconazole) with MIC greater than 4. The resistant isolates were; 83.3% (15) A. fumigatus, 11.1% (2) A. niger and 5.6 % (1) A. terreus. Occurrence of triazole resistant aspergillus species with TR34/L98H mutation in cyp 51A gene from fungicide exposed horticultural soils in Kenya was established. The finding is of public health concern and calls for policies on rational use of fungicides in agriculture over concerns of emerging resistance in clinical practice. There is also need for antifungal drug resistance surveillance among environmental and clinical fungal pathogens.

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Fredholmness Conditions for Operators Perturbed by Orthogonal Idempotents in Banach Spaces

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Let H be an infinite dimensional complex Hilbert space and F_OI (H) the set of all Fredholm operators perturbed by orthogonal idempotents in Banach space. The objective of the study is determine the conditions under which Fredholm operators retain Fredholmness when perturbed by orthogonal idempotents in Banach spaces. The methodology involved tensor products, direct sum decomposition, spectral decomposition and other fundamental principles. The results obtained are contributions of knowledge to the field of functional analysis, particularly in operator theory and Fredholm theory.
Keywords: Fredholm operators; Hilbert space; Orthogonal idempotents; Banach spaces..

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Modified Coulomb's Law for Cooper Pairs in Conventional Superconductors

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Abstract

Cooper pairs are bound entities with attractive interaction provided by the virtual exchange of a phonon between two electrons. Phonon energy is ħω_D where ω_D is the Debye frequency of a given super-conductor. The corresponding Debye temperature θ_D is related to ħω_D via the relation kθ_D=ħω_D. Since the electrons in a Cooper pair are separated by a finite distance (r) called the size of the Cooper pair, there is finite Coulomb repulsion energy (Ec) between the electrons in a Cooper pair. For the Cooper pair to be bound and stable, ħω_D>E_C. It is well known that the electron - electron interaction is screened out exponentially at a distance larger than the Thomas - Fermi radius, rs. Keeping this in mind, a modified Coulomb law for the electron – electron Coulomb interaction in the Cooper pair is proposed. The calculated values for the modified Coulomb energy (Em) are compared with the phonon energy ħω_D and it is found that ħω_D>E_C. for most of the BCS type (conventional) superconductors for which calculations are done in this manuscript.

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AUTOMATED DETERMINATION OF ELECTRICAL TRANSPORT PROPERTIES OF THIN FILMS USING A FABRICATED FOUR-POINT PROBE

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There has been a drastic growth microelectronics industry in the recent past. These industries utilize different materials, the main being semiconductors. The performance of these materials relies on its structural, electrical and optical properties depending on the application. Therefore, there is always a need to undertake measurements of the semiconductor characteristics in a manner that is precise, cheaper and faster. Some of the desirable features of measurements include usability, accuracy, resolution, repeatability, and consistency which cannot be assured with manually operated systems. This study strives to design and interface an automated computer-aided four-point probe system that will provide a means of determining electrical transport parameters such as resistivity, charge carrier type, charge density and carrier mobility. A four-point probe head based on Van der Pauw set up, NI's Keithley's' 6220 Precision current source, NI's Keithley's 6001 switch and NI's Keithley's' 2182A Nanovoltmeter instruments will be interfaced with NI's LabVIEW program running in a computer through a USB to a GPIB hub for its full control. The four-probe head will be used for purposes of probing the samples with a square symmetry that will be adopted for the measurement of the semiconductor electric transport properties. Reliability tests will be carried out by measuring the electrical properties of a standard sample and compare with the expected results. This work will form a basis for automating similar systems that were inherently designed to be operated manually.

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SUPERCONDUCTIVITY IN '122' IRON PNICTIDES

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Superconductivity at high temperature has been discovered in iron-pnictide compounds and this has ignited numerous interest and research on the properties of these compounds. Iron Pnictides in past studies have exhibited superconductivity up to high temperatures of 26K. Eu□Fe□_2 □As□_2 is one of the 122 iron pnictide compounds with a body centered tetragonal crystal structure and has also been seen to exhibit superconductivity on application of pressure of around 2.5Gpa. Superconductivity in these compounds can be achieved through doping or application of pressure on the material. Application of pressure on similar Pnictides such as Barium iron arsenide and Calcium iron arsenide has been seen to tune superconductivity. Superconductivity in materials has various application areas such as in the design of MRI machines and design of cables. Studies on these family of Iron compounds is therefore of great importance.In the recent past and currently, there has been growing interest in the science community on the study of the superconductivity phenomena due to its various advantages and projected future uses in industrial design of various machines. The use of Helium in essential hospital machines such as MRI has proved to be expensive and therefore many patients are unable to access this important health technology. Currently there are a lot of energy loses experienced as a result of using conductors that present some resistance to energy flow, energy losses lead to increased energy costs. Energy use is projected to rise by 56% by the year 2040.(Conti et al., 2016) There is need therefore to develop materials with superconducting properties to eradicate energy losses and improve the standards of living by lowering energy costs. Eu□Fe□_2 □As□_2 is a material that can be of important use in industry due to possession of superconducting properties(Igawa et al., 2009; Miclea et al., 2009; Stewart, 2011)

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Computation of Electronic and Structural Properties of Tin halide Perovskites for Photovoltaic Application by first principles

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Computation of Electronic and Structural Properties of Tin halide Perovskites for Photovoltaic Application by first principles

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Abstract
Lead free perovskites have gained much research interest due to their environmental friendliness. Tin being non toxic has become a viable alternative perovskite and also it has been proven to have lower band gap and wide absorption range compared with the lead counterparts. However the oxidation state of 2+ is still a major setback to achieving higher efficiencies. In this theoretical study the orthorhombic phases of Dimethyl ammonium tin tri-iodide (DASnI3) and Methyl ammonium tin tri-iodide (MASnI3) were studied by first principle calculations based on Density functional theory (DFT) . It was found that a direct band gap was at gamma symmetry points using PBE exchange correlation. Based on comparison with other theoretical and experimental values, the orthorhombic phase of DASnI3 was more stable with the volume of 27.00 a.u.^3 at 544 kbar. It was found that DASnI3 can be more suitable for photovoltaic application compared to the other tin halide perovskites due to its stability.
Key words: first principles, perovskites

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Forecasting Models for the Performance of Selected Orphan Crops in Kenya

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The vagaries of climate change have resulted in decline of the yield and production of major staple crops in Kenya, resulting in food insecurity. The variability of climate has affected production of these crops hence exposing most farm households to food insecurity. To overcome these trends, the Kenyan government in partnership with other development organizations have promoted production of orphan crops such as millet, cassava and sorghum which can adapt well to the climate change. Some of the interventions include; developing high yield and disease resistant varieties, undertaking value addition among others. It is not clear whether these interventions have contributed to the achievement of some of the SDGs such as food security. The study aims at analysing the performance of these orphaned crops in terms of area under production, production and yields, with the aid of time series statistical models and trend analysis. The study found that the yields of these crops have a positive trend, since 1985. However, there is high variability in the yield and production of millet and sorghum although cassava yield and production displayed more stability compared to the other crops. The study also found that after 1980, the production and yield of the crops have a positive trend unlike that of the major crops such as maize and beans. The forecasting models obtained were cassava ARMA (3,0,0) sorghum ARMA (2,0,3) while millet ARIMA (1,0,0). The study recommends that farmers should adopt these crops since the yield per acre is increasing and the production is resistant to climate change. Farmers are encouraged to embrace production of these crops to mitigate climate change shocks.

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AB INITIO STUDY OF TEMPERATURE-DEPENDENT ELASTIC CONSTANTS OF CADMIUM STANNATE AS A SUBSTRATE FOR MANUFACTURE OF MEMS DEVICES

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Silicon (Si) is the dominant substrate used in the manufacture of electronic devices, owing to its excellent electrical and electronic properties. However, the shortcomings of Si, especially its poor mechanical properties such as brittleness of its wafers as they are made thinner (less than 40 mm), limit its applications in the manufacture of minute electronic devices such as Micro-electromechnaical systems (MEMS) devices. The search for suitable semiconductors to replace silicon as a substrate in the manufacture of these device sis on the rise, among them being cadmium stannate (Cd2SnO4), which has been found to possess electrical and electronic properties that are comparable to Si. Moreover, Cd2SnO4 thin films are transparent in the ultraviolet-visible wavelength range. This shades light into the possibility of having transparent MEMS devices. However, not much research has been done on the mechanical properties of Cd2SnO4, although it is among the most crucial properties for MEMS devices that operate under harsh environment. A recent study by Ongwen et al (Ongwen, N., Ogam, E. & Otunga, H. (2020). Ab initio study of elastic properties of orthorhombic cadmium stannate as a substrate for the manufacture of MEMS devices, Materials Today Communications, (In press), 1-7) considered ab-initio study of elastic properties of Cd2SnO4 at the ground state, where the values of elastic constants were found to be comparable to those of Si. However, it is worthwhile noting that MEMS operate under varying temperature conditions. Thus, temperature-dependent elastic constants of Cd2SnO4 are worth looking into. In the present study, we are investigating the

temperature-dependent elastic constants of Cd2SnO4 at a temperature range of 273 – 473 K. a comparison shall also be made with those of Si within the same temperature range. The study is expected to shed more light into the behavior of elastic constants of Cd2SnO4 as temperatures varies.