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Notice for the PhD Viva-Voce Examination

Mr Binish C J (Registration Number: 1981407), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend his PhD thesis at the public viva-voce examination on Monday, 8 January 2024 at 9.30 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

Title of the Thesis	:	**Synthesis, Adsorptive Properties and Applications of Modified Aluminum Oxyhydroxide-PVA Films**
Discipline	:	**Chemistry**
External Examiner (Outside Karnataka)	:	**Dr G Unnikrishnan** Professor National Institute of Technology - Calicut Kozhikode Kerala - 673601
External Examiner (Within Karnataka)	:	**Dr Sanjeev P Maradur** Associate Professor Department of Material Science and Catalysis Poornaprajna Institute of Scientific Research Bidalur Post Bengaluru - 562164 Karnataka
Supervisor	:	**Dr Vijayasankar A V** Professor School of Engineering and Technology CHRIST (Deemed to be University) Bangalore Kengeri Campus Bengaluru - 560074 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 03 January 2024

ABSTRACT

Over the past few years, there has been an increasing interest in polymer films and metal-incorporated polymer films because of their distinctive characteristics and potential applications. The effectiveness of alumina or modified alumina polymer films as adsorbents or catalysts is greatly influenced by their surface properties, texture, chemical composition, and thermal stability. This thesis describes the synthesis of aluminum oxyhydroxide - polyvinyl alcohol composite films by sol-gel method. The synthesized films were modified by incorporating transition metals and cross-linking agents depending on the desired application as a catalyst or adsorbent. The synthesized films were characterized using different techniques, like powder X-ray diffraction studies (pXRD), Fourier transform infrared spectra (FTIR), Raman spectra, Brunauer-Emmett-Teller surface area (BET), Barrett-Joyner-Halenda (BJH) isotherm, atomic force microscopy, optical profilometry, thermogravimetric analysis, scanning electron microscopy (S.E.M), and X-ray photoelectron spectroscopy (XPS) to determine the structural and textural properties.

The films were deployed as adsorbents for the removal of heavy metals and dyes from water as well as catalysts for industrially important organic transformations. The results of the characterization studies were used to correlate the surface characteristics and adsorptive capacities of the fabricated films. The films were found to have tuneable surface properties and enhanced adsorptive behaviour, which could be modified as per the application. Transition metal-incorporated films exhibited remarkable adsorption properties for the elimination of heavy metals and organic dyes from aqueous solution. The adsorption reaction kinetics were investigated to ascertain the rate and mechanism of the reaction to improve the efficiency, economic efficiency and environmental sustainability of the reaction. In addition, aluminum oxyhydroxide-polyvinyl alcohol films incorporated with transition metals exhibited high catalytic activity in organic transformation. The effect of cross-linking agents on catalytic activity has been studied in transesterification reactions. The glutaraldehyde cross-linked films exhibited good catalytic activity along with superior dielectric properties. Optimization studies were conducted to improve the adsorptive and catalytic efficiency with low waste disposal. Finally, the reusability and regeneration of the synthesized films were studied and found to be eco-friendly with low waste generation. In summary, the current study showcases the potential of aluminum oxyhydroxide-polyvinyl alcohol films as a versatile material that can be utilized in diverse applications involving catalysis, adsorption, and dielectric devices.

Keywords: Metal-Aluminum oxyhydroxide PVA films, PVA composite films, transesterification, dielectric properties, Chromium (VI) metal removal, Methylene blue removal.

Publications:

1. **C. J. Binish**, A. V. Vijayasankar, and M.P. Sham Aan, "Synthesis and characterization of Poly-Vinyl Alcohol-alumina composite film: An efficient adsorbent for the removal of Chromium (VI) from water," *Mater. Today Proc.*, vol. 62, pp. 5182–5188, 2022, doi: 10.1016/j.matpr.2022.02.629.
2. **John Binish Chirathadathil**, Viswambaram Vijayasankar Aloor, Raj Somarajan Soorya, et al. Adsorptive removal of Cr (VI) using mesoporous iron-aluminum oxyhydroxide-polyvinyl alcohol self-supporting film: Kinetics, optimization studies and mechanism. *Mater Today Commun.*2023;34:105315, doi: 10.1016/j.mtcomm.2023.105315.
3. **C. J Binish** and A.V. Vijayasankar. (2023) "Correlation of surface properties and catalytic activity of metal aluminophosphates," *Emerging nanomaterials for catalysis and Sensor Applications.*, CRC Press. doi: 10.1201/9781003218708-4.
4. **C. J Binish**, J. Johns, Y. Nakaramonthri, P. Pittayavinai, and A. V Vijayasankar, "Synergetic effects of cross-linking and incorporation of Fe-Al bimetallic combination on the properties of polyvinyl alcohol novel films," *Emergent Mater.*, no. 0123456789, 2023, doi: 10.1007/s42247-023-00506-y.
5. **C. J. Binish**, Kopparapu Imam, A.V Vijayasankar, A.M John, Chundattu Sony J, "Synergistic effect of metals and cross linkers on surface modification of iron aluminum oxyhydroxide-PVA polymer films for enhanced catalytic activity in transesterification reaction," *J Appl Polym Sci*, 2023, doi: 10.1002/app.54778.