Website Information

Department of Physics

Dayananda Sagar University

Faculty details:

Item	Details
Faculty Name	Dr. Vinay Pratap Singh
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Research Area	My research area includes the study of structure and physical properties of metal oxide semiconductors, various nanostructured materials, ceramic composites, as well as glasses and crystalline glass ceramics for different applications as photo catalysts, luminescent materials and ferroelectric & magnetic materials.
Publications (Past 5 years)	1. K. S. Srikanth, **V. P. Singh**, S. Patel, R. Vaish, Pyroelectric performance of $[Bi_{0.48}Na_{0.4032}K_{0.0768}]Sr_{0.04}(Ti_{0.975}Nb_{0.025})O_3$ ceramics, *Journal of the Australian Ceramic Society*, 56, 2 (2020) 395–402. 2. M. Sharma, S. Patel, **V. P. Singh**, R. Vaish, Pyroelectric energy harvesting for dye decolorization using $Ba_{0.9}Ca_{0.1}TiO_3$ ceramics, *Journal of Applied Physics*, 128, 9 (2020) 095108. 3. M. Aggarwal, M. Kumar, R. Syal, **V. P. Singh**, A. K. Singh, S. Dhiman, S. Kumar, Enhanced pyroelectric figure of merits in Sr and Zr co-doped porous $BaTiO_3$ ceramics, *Journal of Materials Science: Materials in Electronics*, 31, 3 (2020) 2337–2346. 4. **V. P. Singh**, D. Mishra, E. N. Kabachkov, Y. M. Shul'ga, R. Vaish, The characteristics of BiOCl/Plaster of Paris composites and their photocatalytic performance under visible light illumination for self-cleaning, *Materials Science for Energy Technologies*, 3, 2 (2020) 299–307. 5. **V. P. Singh**, M. Kumar, B. P. Reddy, Sunny, R. K. Gangwar, C. Rath, Multifunctional hierarchically architectured ZnO for luminescence, photocatalytic, electrocatalytic, and energy storage applications, *Crystals*, 10, 11 (2020) 1025. 6. V. Goyal, **V. P. Singh**, R. Gupta, Inherent property of formation of (001)-oriented vanadium pentoxide nanorods over glass substrate through different techniques and their optical behavior analysis, *AIP Conference Proceedings*, 2220, 1 (2020) 020106.

7. P. Singh, S. S. Chauhan, S. S. Tripathy, **V. P. Singh**, M. A. Quraishi, Electrochemical corrosion inhibition investigations of mild steel in 1 M HCl solution, *AIP Conference Proceedings*, 2220, 1 (2020) 090002.

8. S. K. Sharma, **V. P. Singh**, A. Bhargava, S. H. Park, V. S. Chauhan, R. Vaish, Surface crystallization of BiOCl on $2Bi_2O_3–B_2O_3$ glasses for photocatalytic applications, *Materials in Electronics*, 32, 8 (2021) 10520.

9. **V. P. Singh**, M. Kumar, M. Sharma, D. Mishra, K. S. Seong, S. H. Park, R. Vaish, Synthesis of BiF_3 and BiF_3-added plaster of Paris composites for photocatalytic applications, *Energies*, 14, 16 (2021) 5159.

10. D. Nath, P. Azad, S. M. Ibrahim, **V. P. Singh**, Antibacterial and photocatalytic performance of eggshell-derived CaF_2-mortar cement composites, *Journal of the Australian Ceramic Society*, 59, 1 (2023) 93–103.

11. N. Alwadaia, **V. P. Singh**, M. A. Huwayz, Z. A. Alrowaili, I. Kebaili, I. Boukhris, et al., Pyro-catalytic activities of cement-based $BaTiO_3$, *Integrated Ferroelectrics*, 237, 1 (2023) 133–139.

12. N. Alfryyan, **V. P. Singh**, Z. M. Elqahtani, Z. A. Alrowaili, I. Kebaili, I. Boukhris, et al., Effect of poling on electrochemical properties of $Ag/Ba_{0.85}Ca_{0.15}Zr_{0.1}Ti_{0.9}O_3$ composites, *Environmental Progress & Sustainable Energy*, 43, 1 (2023) 14298.

13. F. M. Alzahrani, **V. P. Singh**, K. M. Katubi, N. S. Alsaiari, I. Kebaili, I. Boukhris, et al., Electrochemical and photocatalysis properties of $Bi_{0.5}(Na_{0.9}K_{0.1})_{0.5}TiO_3$-based ceramics, *Integrated Ferroelectrics*, 240, 1 (2024) 46.

14. A. Kumar, S. P. Singh, **V. P. Singh**, Effect of pressure on vertically aligned ZnO nanorods for piezoelectric nanogenerator application, *Journal of Condensed Matter*, 2, 2 (2024) 99.

15. M. Kumar, P. K. Jindal, **V. P. Singh**, S. Sharma, S. H. Park, ZnO quantum dot phosphors converted white light emitting diode, *Journal of Ovonic Research*, 21, 2 (2025) 177.

16. **V. P. Singh**, M. Kumar, A. Kumar, S. Sharma, C. Rath, S. H. Park, Analysis of heat treatment on hydrogen impurities associated to Zn vacancy and other intrinsic defects in ZnO nanoparticles, *Journal of Ovonic Research*, 21, 2 (2025) 217.

Sponsored Projects (Past and Ongoing)	1. **Project Title:** Visible light active photo catalytic transparent glass ceramic for waste water treatment and self cleaning applications. **Application ID:** 1-57 27975595 (PI) **Domain**: Advanced Materials **Sponsors:** Governed by AICTE & Funded by NPIU(MHRD) **Budget Approved (INR):** 1908756/- 2. **Project Title:** Solid state refrigeration by using multi caloric effect in ferroelectric materials and applications. **Application ID:** 1-57 58719271 (Co-PI) **Domain**: Energy **Sponsors:** Governed by AICTE & Funded by NPIU(MHRD) **Budget Approved (INR):** 1400000/- 3. Development of sub-one-volt and optically transparent TFTs for low cost and low power consuming devices. **Application ID:** 1-57 68252651 (Co-PI) **Domain**: Energy **Sponsors:** Governed by AICTE & Funded by NPIU(MHRD) **Budget Approved (INR):** 1985000/- 4. **Project Title:** Green Inhibitors for the application of corrosion protection of metals and alloys. **Grant Number:** RTU/TEQIP-III/F(56)/2019-20/2268 (Co-PI) **Domain**: Corrosion science **Sponsors:** Governed by *RTU Kota* **Budget Approved (INR):** 200000/-
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Research Activities (Write about your best research results max of 2-3 pages including diagrams)

1- Photocatalytic, hydrophobic and antimicrobial characteristics of ZnO nano needle embedded cement composites:

In this work, ZnO nanoneedles were synthesized employing a co-precipitation method. Further, white cement composites were prepared with ZnO filler of 5%, 10% and 15% by weight ratio. With the increasing concentration of ZnO in cement matrix the synergetic effect between ZnO and white cement matrix was observed through FE-SEM and UV–visible. We studied the photocatalytic degradation of pollutant (Rhodamine 6G)

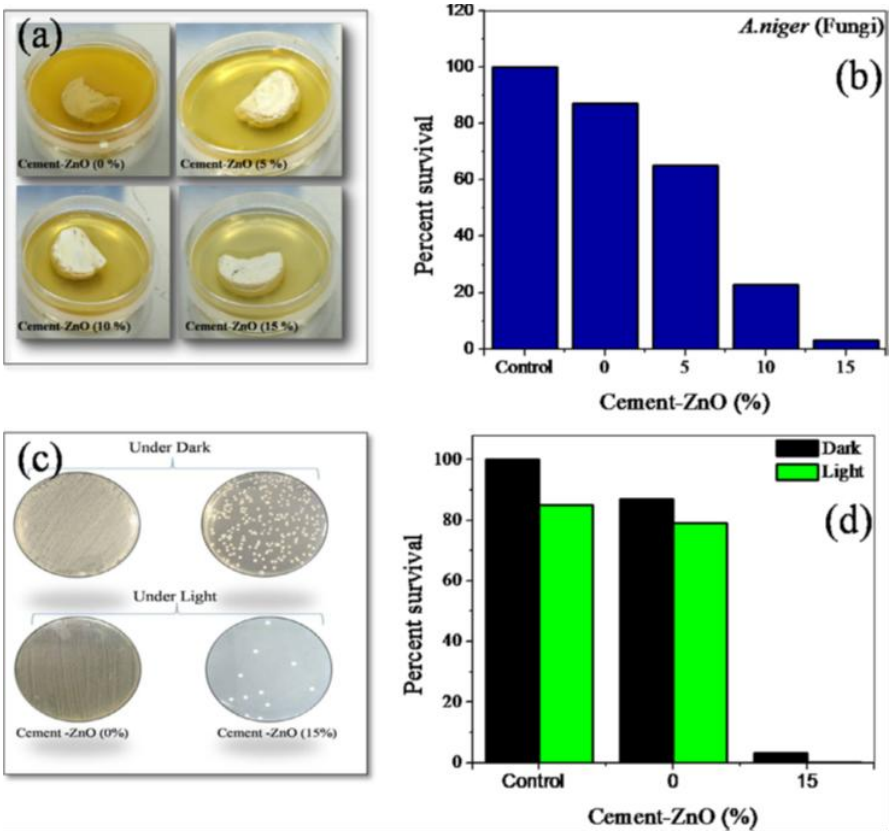

Figure 1 Antifungal activity of Cement-ZnO composite on A.niger. (a) Fungal growth was observed on the surface of cement without ZnO but no fungal growth was observed on ZnO containing cement composites (b) Antifungal effect of Cement-ZnO composite increases with increase in ZnO concentration. (c) Colony forming units plates under light and dark. (d) Percent survival of A.niger assessed by plate counting method under light and dark.

using ZnO nano-needles embedded in white cement matrix under ultraviolet irradiation (UV) along with enhanced hydrophobic nature and the antimicrobial property of the cement. The pseudofirst order kinetics was found in a photocatalytic process, and degradation rate constant was enhanced up to 0.147 min-1 for ZnO modified cement which was significantly higher than the pure cement (0.037 min_1). Antimicrobial studies were performed using bacterial strains Escherichia.coli (JM109, Promega Gram negative), Bacillus subtilis (MTCC121, Gram-positive) and fungal strain Aspergillus niger (MTCC281) for all the composites. A

significant improvement in bacterial and fungal degradation was observed in ZnO modified cement than control and pure cement in a dose-dependent manner.

2. **The characteristics of BiOCl/Plaster of Paris composites and their photocatalytic performance under visible light illumination for selfcleaning.**

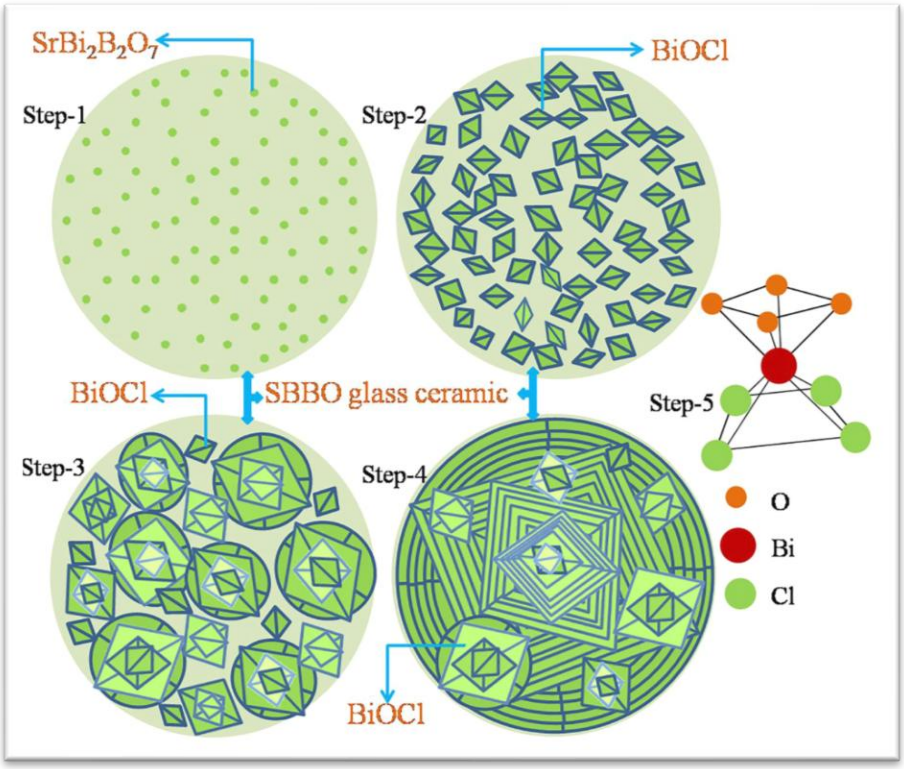

Figure 2 Schematic diagram of the growth of BiOCl over SBBO glass ceramic after etching SBBO from HCl solutions of different concentration.

In this work, **we** have grown hierarchical structure of bismuth oxycloride (BiOCl) on SrO-Bi2O3-B2O3 (SBBO) transparent glass ceramic. SBBO glass-ceramics were fabricated via conventional melt-quenching technique while BiOCl was grown by etching the glass via HCl. Enhanced visible light driven photocatalytic activity and increasing hydrophobic feature were observed on BiOCl grown SBBO than as quenched SBBO glass ceramics. Contact angle analysis showed maximum contact angle of 130.7o on the surface of most BiOCl grown SBBO glass ceramic. Further, under visible light illumination water contact angle decreased from 130.7 o to 30.8o. Such photo induced hydrophilicity and catalytic performance in translucent glass ceramics lead self-cleaning applications.

3- The characteristics of BiOCl/Plaster of Paris composites and their photocatalytic performance under visible light illumination for selfcleaning.

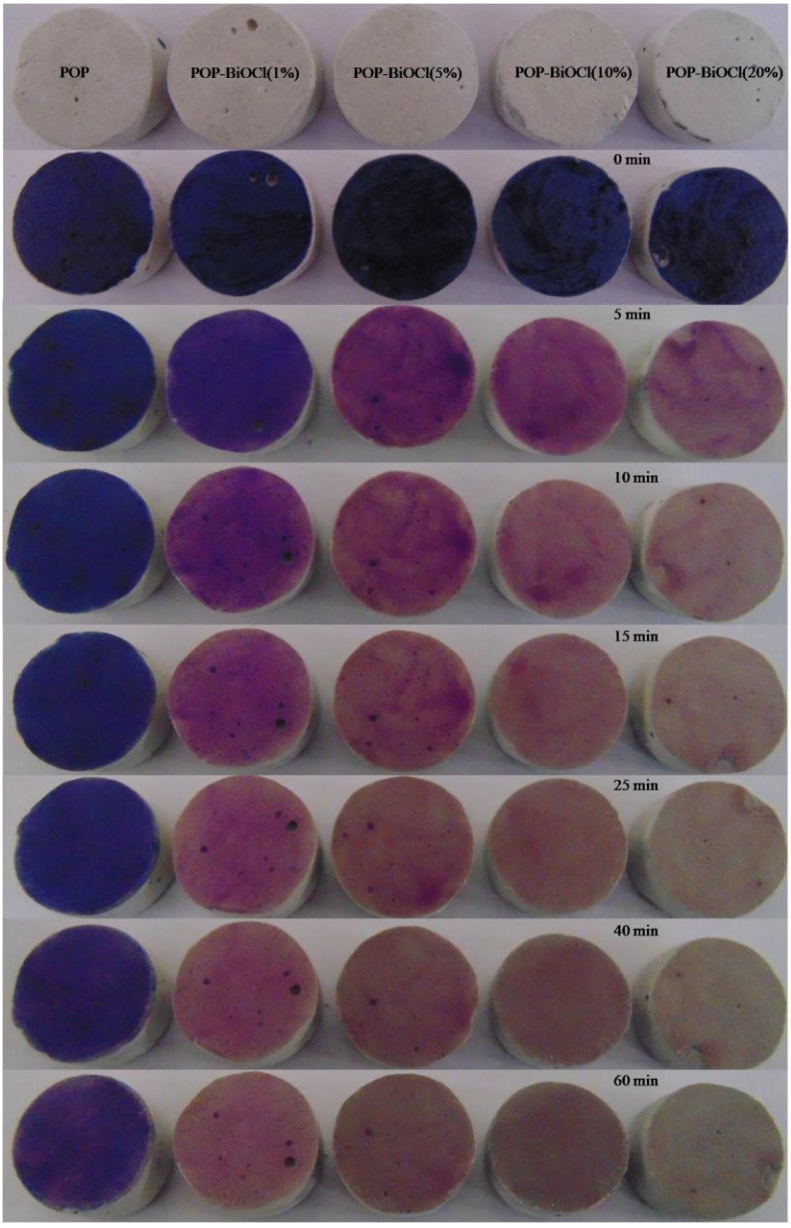

Figure 3 Photo-reduction of Rz indicator ink for 1 h reaction timeline for POP-BiOCl (%) composites under visible light irradiation.

In this work the composites of Plaster of Paris (POP)-BiOCl (%) are prepared by adding BiOCl of 0%, 1%, 5%, 10% and 20% (by wt.) in the POP matrix. The band gap of the BiOCl powder is calculated about 3.31 eV. Resazurin (Rz) ink is used as an indicator to monitor the photocatalytic activity and self-cleaning property of POP-BiOCl (%) composites under the visible light and the resultant decolourisation of Rz ink is directly

	related to the photocatalytic performance of the material. Optical images of the coating of Rz ink over the surfaces of POP-BiOCl (%) composite pellets confirmed a steady color change from blue to pink within 60 min time duration. Finally, the rate of decolourisation of Rz ink was calculated by measuring the absorption at two (581 nm and 630 nm). Digital photographic methods as well as UV–visible absorption studies are performed to examine qualitative and quantitative decolourisation of the Rz ink.
Collaborations	• Prof. Chandana Rath, Associate Professor, S.M.S.T. IIT (BHU), Varanasi, UP, India. • Prof. Rahul Vaish, Associate Professor, School of Engineering, IIT Mandi, Himachal Pradesh, India.
Awards and Recognition	• TPSI Founder President's Award (Silver Medal) during ***"6th National Conference on Thermophysical Properties"*** Department of Applied Physics, Institute of Technology, BHU during October 11-13, 2011. • Elected for the faculty level students' council, IIT(BHU), 2012.