Indian Institute of Technology, Gandhinagar

Summer Research Internship Program

Nanoengineered Surface for Fouling/Antifouling Properties

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Abstract

This research report focuses on the study of nanoengineered surfaces for fouling and antifouling properties. Experiments were conducted on bare copper and copper coated with different nanosheets, such as HTMS, Fullerene, TiB_2, CuO, CuO + HTMS, and LIS. The investigation involved exposing these materials to $CaSO_4$ solution at a fixed concentration of 1g/L and temperatures of 70-75°C to observe the fouling behavior.

Introduction

The aim of this research was to study the fouling and antifouling properties of copper and to examine how these properties are influenced by coating the copper with various nanosheets. Copper (both bare and coated) was immersed in $CaSO_4$ solutions at a concentration of 1g/L and temperatures of 70-75°C to observe the extent and nature of fouling.

Research Objectives

The objective of this research was to understand the fouling and antifouling properties of bare copper and copper coated with different nanosheets. Specifically, the study aimed to identify the nanosheet coating (HTMS, Fullerene, TiB_2, CuO, CuO + HTMS, or LIS) that results in the least amount of fouling. This study sought to enhance our understanding of how nanoengineering can improve the antifouling characteristics of surfaces, which has significant implications for various industrial applications.

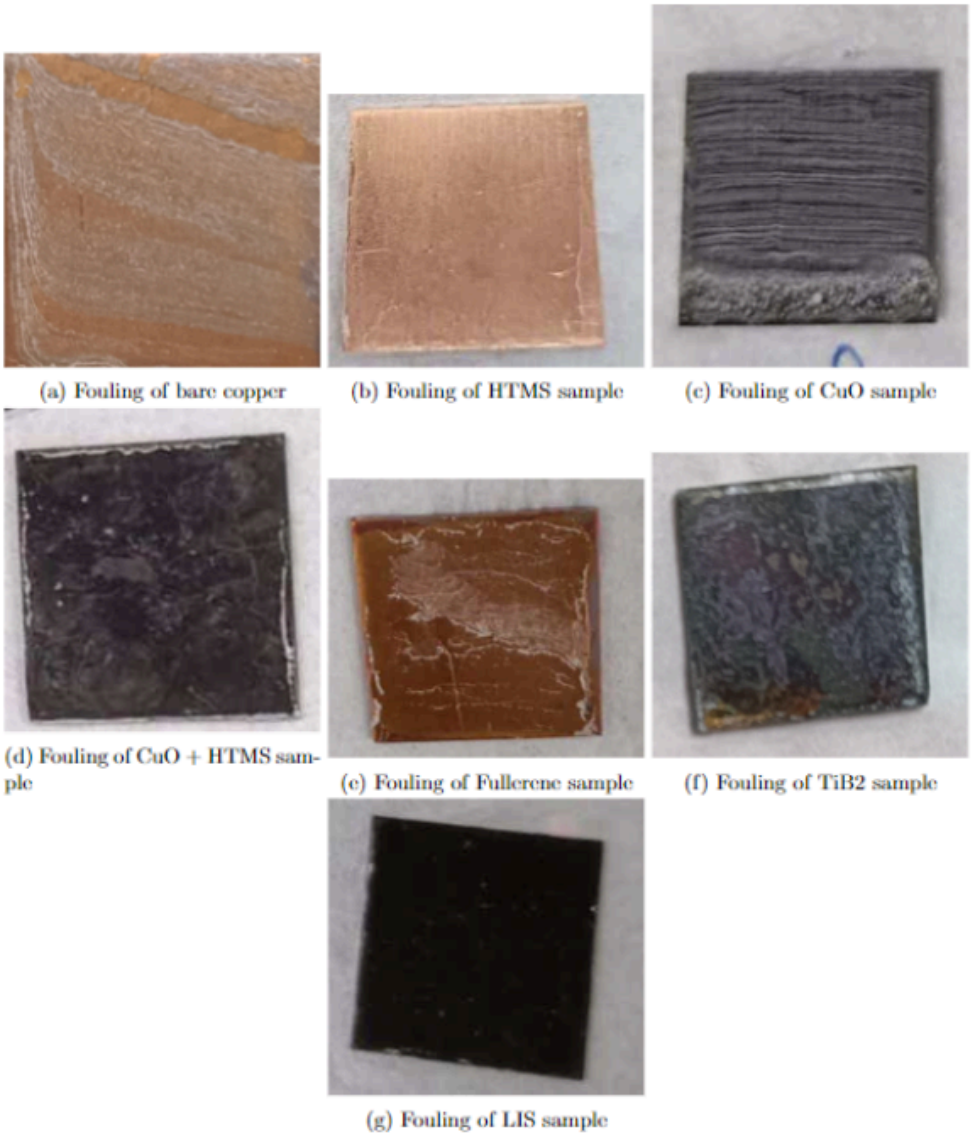
Methodology

1. All copper samples (bare and coated) were cleaned using a standardized procedure to remove any contaminants.
2. Each sample was weighed to record the initial mass.
3. $CaSO_4$ solutions were prepared at a concentration of 1g/L.
4. Each copper sample (bare and coated) was immersed in the $CaSO_4$ solutions.
5. The solutions were heated to a temperature range of 70-75°C, and fouling was allowed to occur at a constant temperature.
6. After fouling had occurred, each sample was carefully removed from the solutions, dried, and weighed again to determine the final mass.
7. The mass increase due to fouling was calculated by subtracting the initial weight from the final weight.
8. The bare copper sample served as the reference.

9. The fouling levels of coated samples were compared to the bare copper to determine the effectiveness of each nanosheet coating in reducing fouling.

Observation

1. TiB2 fouls the most.item
2. LIS fouls the least



(a) Fouling of bare copper (b) Fouling of HTMS sample (c) Fouling of CuO sample

(d) Fouling of CuO + HTMS sample (e) Fouling of Fullerene sample (f) Fouling of TiB2 sample

(g) Fouling of LIS sample

Figure 1: Fouling behavior of different copper samples

Errors and Limitations

1. The fouling on bare copper was insufficient; therefore, even though LIS fouls, its percentage is almost near zero.
2. The weighing balance can measure only in milligrams and cannot measure weights smaller than that.
3. We need to optimize the setup so that the fouling can be increased.
4. Even with an increase in concentration, the fouling is not increasing sufficiently.

Conclusion

Based on the current study, we observed that the fouling on bare copper was insufficient, impacting the overall accuracy of our measurements. Notably, the Liquid-Infused Surface (LIS) demonstrated the least amount of fouling across all samples tested so far. Our weighing balance can only measure in milligrams, which limits the precision of our measurements and affects the reliability of the data collected.

To improve the accuracy of our fouling measurements, it is essential to optimize the experimental setup. This optimization aims to increase the degree of fouling observed. However, despite current adjustments in concentration, the fouling has not significantly increased, indicating a need for further optimization of the experimental conditions. By enhancing the setup, we hope to achieve more accurate and reliable quantification of fouling in various samples.