XXI Brazilian Meeting on Inorganic Chemistry
X Brazilian Meeting on Rare Earths
III Workshop on Theoretical Bioinorganic Chemistry
Belo Horizonte, September 12 - 15th 2024

Mechanical synthesis of β-amino-α-carbethoxy ethyl acrylates as corrosion inhibitors for mild steel in acid media

Caio M. Fernandes[1], Mayra S. Coutinho[1,2], Mylena C. Leite[1], Vinicius Martins[1], Mariana P. Batista[1], Leticia V. Faro[1], Awad A. Al-Rashdi[3], Júlio César M. Silva[1], Pedro N. Batalha[1], Hassane Lgaz[4], Eduardo A. Ponzio[1]

[1] Chemistry Institute, Universidade Federal Fluminense, Niterói, Brazil
[2] Instituto Federal de Educação, Ciência e Tecnologia do Paraná, Palmas, Brazil
[3] Chemistry Department, Umm Al-Qura University, Al-Qunfudah University College, Saudi Arabia.
[4] Center for Creative Convergence Education, Hanyang University ERICA, Korea
E-mail:pedrobatalha@id.uff.br

Thematic Area: Supramolecular Chemistry

Keywords: malonic esters; green chemistry; corrosion

Carbon steel is extensively used in the industrial sector due to its cost-effectiveness and desirable properties such as strength, ductility, and weldability. However, its susceptibility to corrosion, due to the absence of expensive alloying elements like nickel and chromium, leads to significant economic and environmental issues.[1] To mitigate this, corrosion inhibitors (CIs) have emerged as an effective and economical solution, with organic corrosion inhibitors (OCIs) gaining popularity due to their high efficiency, low cost, and low toxicity.[2] This study investigates the anticorrosion efficiency of two β-amino-α-carbethoxy ethyl acrylate derivatives (EOAB and DBMM) for 1020 carbon steel in 1 mol L^{-1} HCl.

These compounds were synthesized using a solvent-free method. Benzylamine or 3-aminobenzoic acid were condensed with diethyl ethoxymethylenemalonate (EMME) by manually grinding the reactants in a mortar, completing the reactions in, respectively, one and 25 minutes. Both derivatives were synthesized in quantitative yields, demonstrating an efficient and greener adaptation of the classical EMME/amine condensation method.[3] The structures of EOAB and DBMM were confirmed through IR, ^{1}H NMR, ^{13}C-APT NMR, and HRMS analyses.

Both inhibitors demonstrated significant corrosion mitigation, with EOAB showing over 85% efficiency and DBMM exceeding 90% at a 1.00 mmol L^{-1} concentration. Even at elevated temperatures, both inhibitors maintained notable efficiency, significantly reducing the corrosion rates compared to the blank solution. Gravimetric measurements, electrochemical experiments, and surface analyses were conducted to understand the inhibitors' behavior and corrosion mechanisms. Additionally, SCC-DFTB simulations and quantum chemical calculations suggested that both inhibitors are capable of strongly interact with the iron surface through their carbon and oxygen atoms, shielding it against the acid media.

The results underscore the potential of EOAB and DBMM as effective OCIs, contributing to greener and more efficient corrosion prevention strategies in industrial applications.

Acknowledgments: PPGQ-UFF, CAPES (Financing Code 001), FAPERJ, CNPq, Deanship of SRUAQU

References

[1] N. Hassan et al. Colloids and Surfaces A: Physicochemical and Engineering Aspects, 607 (2020).
[2] M. Oubaaqa et al. Journal of Applied Electrochemistry, **52,** 413-433 (2022).
[3] A. Ilangovan et al. Chemistry – A European Journal, **16,** 2938-2943 (2010).