

Corona-Boosted Piezocatalysis: Transforming Ferroelectric Materials for Enhanced Water Splitting

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Piezocatalysis enables mechanical-energy-driven redox reactions, offering promising pathways for pollutant degradation and sustainable hydrogen production¹. Yet, the mechanisms by which corona discharge treatment enhances catalytic performance in ferroelectric materials remain poorly understood. Here, we show that high-voltage corona processing of barium titanate (BaTiO₃) and potassium sodium niobate (K_{0.5}Na_{0.5}NbO₃) induces crystallographic reorientation and strengthens surface polarization via dipole realignment and field-induced defect formation. Structural analysis confirms an increase in polar phase content, while electrochemical measurements including Tafel analysis demonstrate accelerated charge transfer kinetics, with significantly enhanced current response after treatment. In piezocatalytic testing, corona treated KNN achieved ~95% degradation of Rhodamine B within 120 minutes, significantly outperforming untreated samples. In hydrogen evolution experiments, both BTO and KNN surpassed our previously reported platinum decorated BaTiO₃ benchmark, generating over 30% more hydrogen without noble metal loading². These findings uncover the mechanistic basis for corona-enhanced piezocatalysis and position corona-treated ferroelectrics as scalable, high-efficiency catalysts for energy and environmental applications.

References

- [1] Meng, N., Liu, W., Jiang, R., Zhang, Y., Dunn, S., Wu, J., & Yan, H. "Fundamentals, advances and perspectives of piezocatalysis: A marriage of solid-state physics and catalytic chemistry", *Progress in Materials Science* 138 (2023): 101161.
- [2] Subramaniam, G., Billing, M., Nguyen, H.P., Nguyen, N., Le, B.T., Park, S., Sathasivam, S, Pham, T.T. and Dunn, S., "Enhanced Piezocatalytic Water Splitting by Platinum-Decorated Barium Titanate", *Advanced Sustainable Systems* 8.12 (2024): 2400265.