

## Inhibition behavior of N-doped carbon quantum dots derived from *Camellia oleifera* shell for carbon steel in HCl

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**Abstract:** Carbon quantum dots (CQD), one of the most common zero-dimensional carbon nanomaterial, show great applied potential in the field of corrosion inhibition, owing to the advantages of wide sources, low price and environmental friendliness. In this work, a novel N-doped carbon quantum dots (N-CQD) were synthesized using a hydrothermal method with *Camellia oleifera* shells (COSE) as the raw materials. The chemical compositions of the as-prepared N-CQD were comprehensively analyzed by transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), and infrared absorption spectroscopy (FTIR). The corresponding corrosion inhibition effect of N-CQD for carbon steel in 1.0 M HCl solution was systematically studied by weight loss method, electrochemical impedance spectroscopy, and potentiodynamic polarization tests. Moreover, the protective effect and also hydrophobic properties of carbon steel modulated by N-CQD in HCl were further investigated by atomic force microscopy (AFM), contact angle tests, and also other techniques. Scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS) were employed to inspect the morphology and compositions of carbon steel influenced by N-CQD in 1.0 M HCl solution. All these above-mentioned results show that the novel green N-CQD prepared by COSE can effectively restrain the corrosion of carbon steel in 1.0 M HCl, which can always afford the inhibition efficiency of >87% within 20-30 °C. The deep analysis of electrochemical test results reveals that the N-CQD can inhibit both the cathodic and anodic reactions, thus leading to excellent anti-corrosion performance.

**Keywords:** *Camellia oleifera* shells, N-doped carbon quantum dots (N-CQD), anti-corrosion effect, carbon steel

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