Synergistic inhibitive effect and related quantum chemical parameters of 2-ethoxy-4,6-dimethylnicotinonitrile and iodide ions on corrosion of mild steel in sulfuric acid

Punita Mourya, R. B. Rastogi, M. M. Singh
Department of Chemistry, Indian Institute of Technology (Banaras Hindu University) Varanasi , Varanasi 221005, India

What is Corrosion?
An irreversible, interfacial reaction of a material with its environment which results in a consumption of the material or in dissolution of a component of environment in to the material.

Corrosion Inhibitor
An Inhibitor is a substance which decreases the corrosion rate when present in the corrosive system in a suitable concentration without significantly changing the composition of corrosive agent.

Inhibitors retard the corrosion process by:
- Increasing the anodic, cathodic or both polarizations
- Reducing the movement or diffusion of ions through the interface.
- Increasing the electrical resistance of metal environment interface.

Results and discussion
- Potentiodynamic polarization and Electrochemical impedance spectroscopic measurements
- Langmuir adsorption isotherm

Gravimetric, potentiodynamic, linear polarization and EIS parameters as well as inhibition efficiency values in the absence and presence of different concentrations of EDMNN at 298 K

Inhibitor | Cm(mM) | Cw(mg cm⁻²) | ƞ | Ecorr(mV vs. Ag/AgCl) | icorr(µA cm⁻²) | ƞ | Rct(Ω cm²) | Rp(Ω cm²) | ƞ |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Blank</td>
<td>0.0</td>
<td>3.194</td>
<td>---</td>
<td>-513</td>
<td>2346</td>
<td>---</td>
<td>15.0</td>
<td>9.8</td>
<td>---</td>
</tr>
<tr>
<td>EDMNN</td>
<td>0.5</td>
<td>1.296</td>
<td>59.4</td>
<td>-491</td>
<td>1050</td>
<td>55.2</td>
<td>36.1</td>
<td>58.4</td>
<td>23.0</td>
</tr>
<tr>
<td>1.0</td>
<td>1.115</td>
<td>65.1</td>
<td>-503</td>
<td>750</td>
<td>68.0</td>
<td>45.9</td>
<td>67.3</td>
<td>32.1</td>
<td>69.4</td>
</tr>
<tr>
<td>1.5</td>
<td>0.885</td>
<td>72.3</td>
<td>-484</td>
<td>641</td>
<td>72.6</td>
<td>76.2</td>
<td>76.6</td>
<td>43.7</td>
<td>77.5</td>
</tr>
<tr>
<td>2.0</td>
<td>0.632</td>
<td>80.2</td>
<td>-477</td>
<td>476</td>
<td>80.0</td>
<td>87.6</td>
<td>82.8</td>
<td>50.3</td>
<td>80.6</td>
</tr>
<tr>
<td>KI</td>
<td>2.0</td>
<td>1.492</td>
<td>53.3</td>
<td>-502</td>
<td>1054</td>
<td>55.1</td>
<td>34.6</td>
<td>56.5</td>
<td>22.6</td>
</tr>
<tr>
<td>EDMNN+KI</td>
<td>2.0</td>
<td>2.0</td>
<td>0.029</td>
<td>99.0</td>
<td>-480</td>
<td>113.0</td>
<td>95.2</td>
<td>192.4</td>
<td>92.2</td>
</tr>
</tbody>
</table>

Optimized structure
4.6-dimethyl-2-ethoxy-1,2-dihydro-pyridine-3-carbonitrile (EDMNN)  

Conclusion
- EDMNN is a good inhibitor and ƞ value is a function of concentration.
- Polarization measurements show that EDMNN acts as mixed inhibitor.
- The adsorption of EDMNN obeys Langmuir adsorption isotherm.
- The mechanism between iodide anion and EDMNN cation is confirmed from XPS study.
- Theoretical study has been able to establish the link between the inhibitive effect and the electronic properties of EDMNN.

References