Dendritic semi fractal structures of copper nano-catalysts for efficient electro-reduction of CO₂ into potent fuel products

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Sequestration and reduction of CO₂ is the current flare of scientific researchers. Copper and its oxides have been found to be ample for efficient and selective reduction of CO₂ [1-3]. Given if shape of nano-catalysts is nano-hotspot active, adds the magnitude of efficiency and selectivity of desired products [4]. As the solubility of CO₂ in organic solvents is high comparatively to aqueous ones, these are eyed as potent medium of reduction [5].

Keeping the aspirations and key parameters in mind for facile and enhanced CO₂ reduction, we synthesized highly dendritic, fractal and polygonal nano-particles of copper. pXRD confirmed formation of FCC lattice of Cu(0) at advocacy of JCPDS card no 89-2838.

Figure 1: XRD plots of samples showing (111), (200), (220) and (311) plane sets of Cu(0) FCC lattice

Synthesized materials had extensively branched dendritic structure and some typically edged octahedrons were also found under SEM and TEM analysis. All four differently prepared materials were found to grow in similar tree like shapes except some materials acquiring near to true fractal pattern and some a pseudo-fractal pattern. Figure 2 shows morphology of prepared materials as revealed by SEM and TEM.

In a conventional three electrode system with a potentiostat, reduction of CO₂ was studied by cyclo-voltammograms first with bare GC in argon saturated DMSO followed by a scan in CO₂ saturated DMSO. Both argon saturated

CV scan and CO₂ saturated scan were studied for all of the samples. GC was found to be irresponsive to CO₂ while all four materials showed much enhanced current suggesting efficient reduction of CO₂ current density as appreciable as 3.75 mA/cm² (Figure 3).

Figure 2: SEM (left image) and TEM (right side image) highlighting tree like shapes of samples prepared at diff. applied voltage

Figure 3: CVs in argon and CO₂

References

1. Yoshio Hori, Akira Murata, j. chem. Soc.1,1989,85(8).
2. Marc Beley,jean paul, J. Am. Chem. Soc,1986,108
3. D.A Lowy,M.Toma, review j. applied chem.27 1997.
4. J O'M Bockris, Z.S Minevski,Electrochem. Acta 39(1994).
5. Bard and Faulkner, Electrochemistry, Wiley,1984.