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Effect of the carbon nanotube buffer layer on the performance of Li metal battery

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The calculations of the volume density and specific area of the CNT film

The volume density of the CNT film can be calculated as follows,

$$P=\rho_f/\rho_c \quad \text{(S1)}$$

where ρ_f is the density of the CNT film, ρ_c is the true density of CNT. By calculating a single CNT model, ρ_c was obtained as about 1.85 g cm^{-3}.[S1] ρ_f was calculated by

$$\rho_f=m/S_f d \quad \text{(S2)}$$

where m, S_f, and d are the mass, area, and thickness of the CNT buffer layer. Through the formula 2, the ρ_f is calculated as 0.45 g cm^{-3}. So the CNT film has a volume density of 24%, leaving 76% volume of the film to form pores.

From the SEM image of the CNT film, we regard the film to be a long wire winded as a mesh, we assume the wire have a diameter as $2r$, a length of l, so the surface area can be calculated as

$$S=2\pi rl/m \quad \text{(S3)}$$

m is the mass of the CNT film, and can be calculated as

$$m=\pi r^2 l\rho_c \quad \text{(S4)}$$

ρ_c is the true density of CNT mentioned above, so formula 3 can be reduced to

$$S=2/r\rho_c \quad \text{(S5)}$$

From the SEM image, the r is about 15~30 nm, we take it to be 22 nm. So the S is 50 m^2 g^{-1}.

References

S1. Y. L. Yin, C. H. Liu and S. S. Fan, *J. Phys. Chem. C.*, 2012, **116**, 26185-26189.