# Facile one-step preparation of Ni-doped MIL-53(Fe) metal-organic framework for efficient hybrid supercapacitor performance

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## 1.1 Preparation of method of electrode in three-electrode system

The MOF materials, acetylene black, and polyvinylidene difluoride (PVDF) were first combined in a 8:1:1 weight ratio. Next, the proper quantity of N-methyl pyrrolidone was added and mixed thoroughly to form a slurry and then pasted on a pre-cleaned 1 cm x 1 cm nickel foam and dried at 60 $^0$C for 12 h. After drying, the prepared materials were pressed at a pressure of 10 MPa to create the working electrode. Acetylene black is added to compensate for the conductivity loss brought on by the addition of PVDF, which serves as a binder among them [1].

## 1.2 Preparation method of electrode in two-electrode test system

The hybrid device (MIL-53(Fe)-Ni-2//AC) was assembled with AC as the negative electrode and MIL-53(Fe)-Ni-2 as the positive electrode. The preparation of the MIL-53(Fe)-Ni-2 and AC electrodes was identical to that of the electrodes used in the three-electrode test system. **Equation (1)** was used to satisfy the charge balance between the MIL-53(Fe)-Ni-2 and AC electrodes [2].

$$\frac{m_+}{m_-} = \frac{Cs_- \times V_{S-}}{3.6Q_{S-}} \quad (1)$$

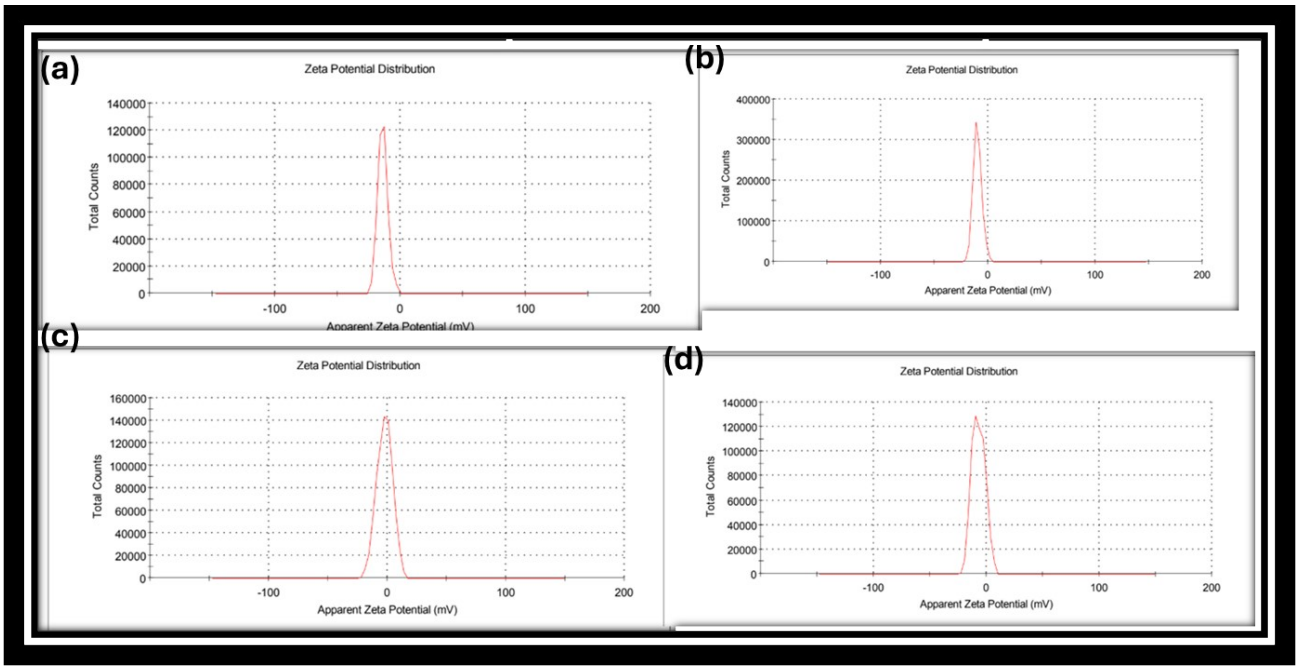


**Fig S1:** Zeta potential plots of (a) MIL-53 (Fe) (b) MIL-53(Fe)-Ni-1, (c) MIL-53(Fe)-Ni-2, (d) MIL-53(Fe)-Ni-3

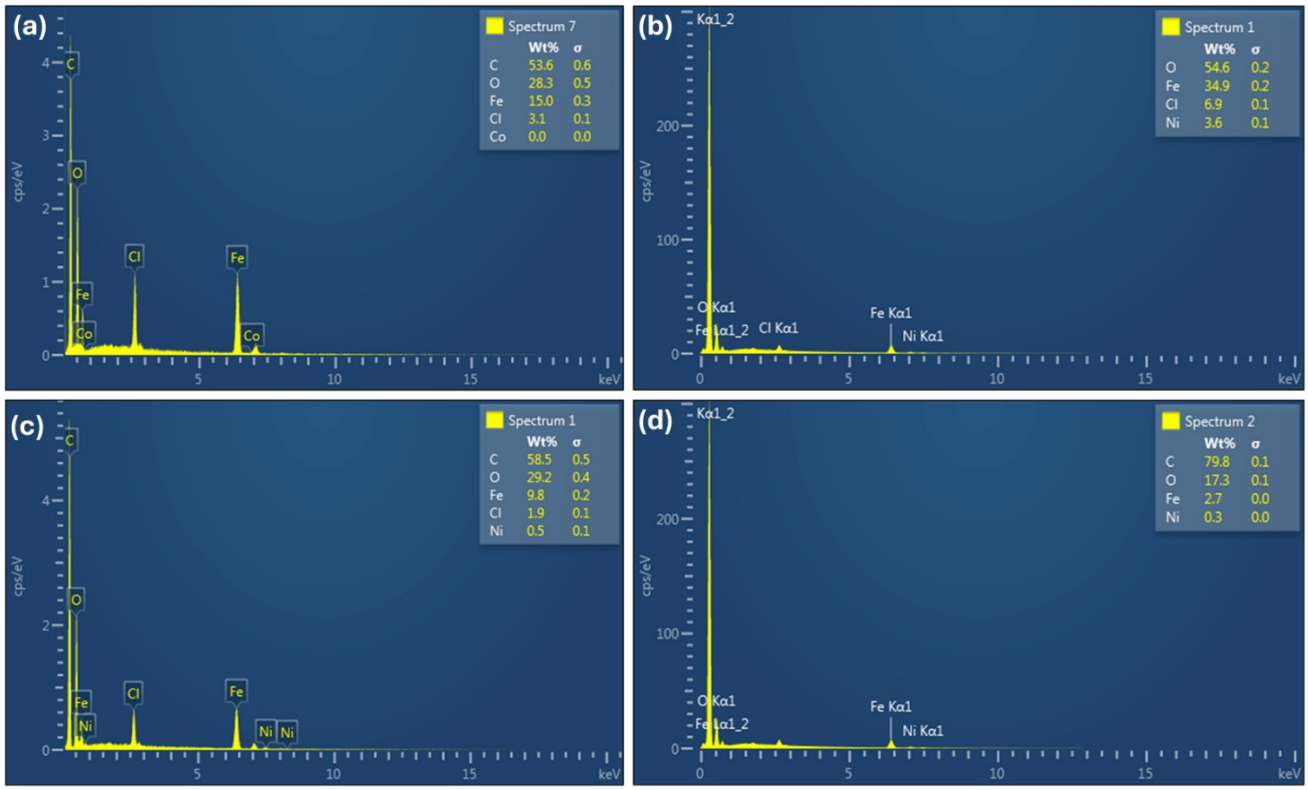


**Fig. S2**: EDS spectra of (a) MIL-53 (Fe) (b) MIL-53(Fe)-Ni-1, (c) MIL-53(Fe)-Ni-2, (d) MIL-53(Fe)-Ni-3

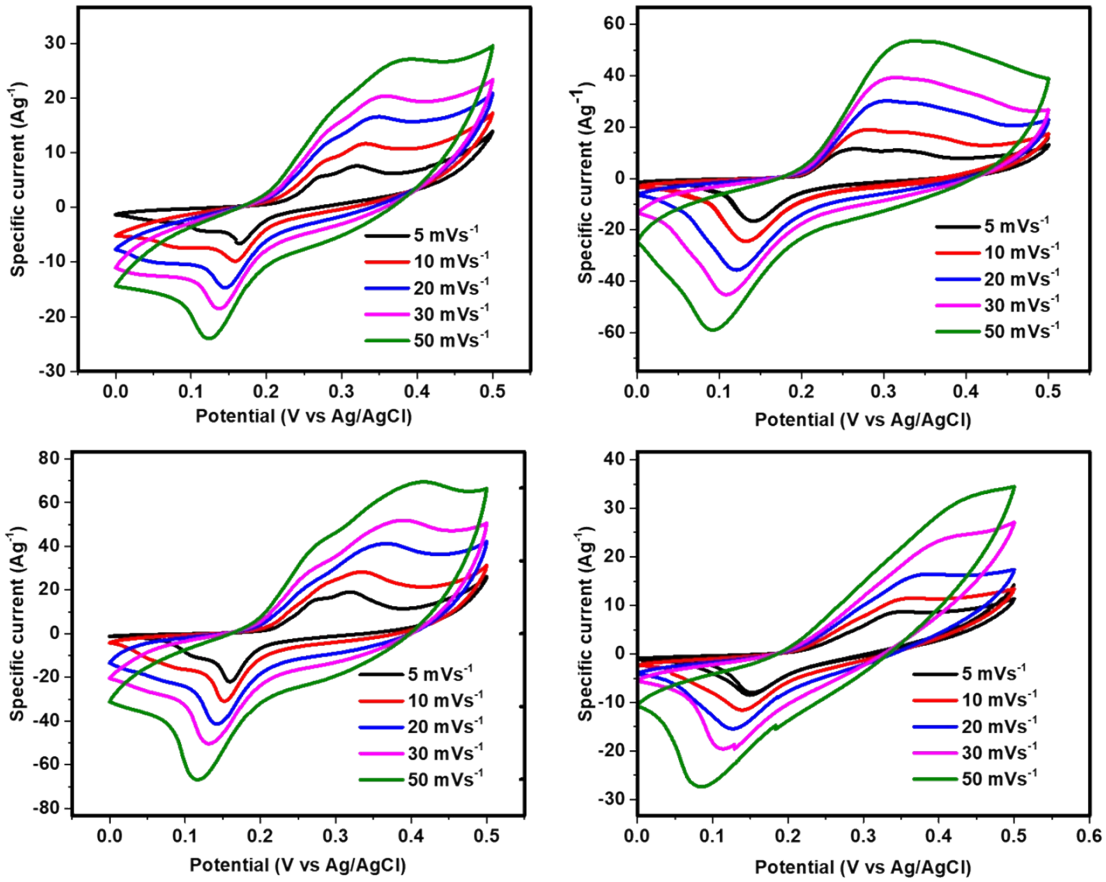


**Fig. S3**: CV curves of (a) MIL-53 (Fe) (b) MIL-53(Fe)-Ni-1, (c) MIL-53(Fe)-Ni-2, (d) MIL-53(Fe)-Ni-3

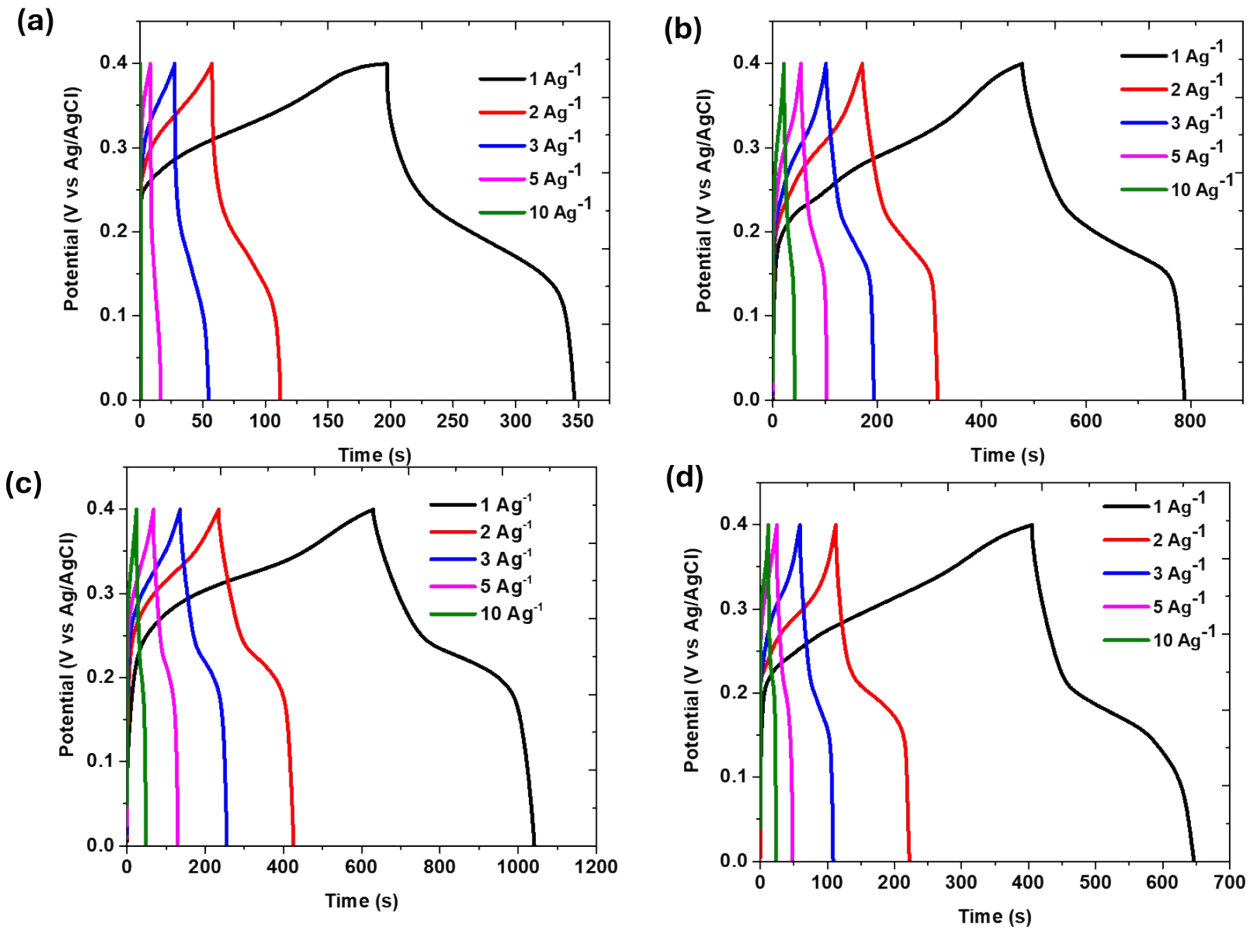


**Fig. S4**: GCD curves of (a) MIL-53 (Fe) (b) MIL-53(Fe)-Ni-1, (c) MIL-53(Fe)-Ni-2, (d) MIL-53(Fe)-Ni-3

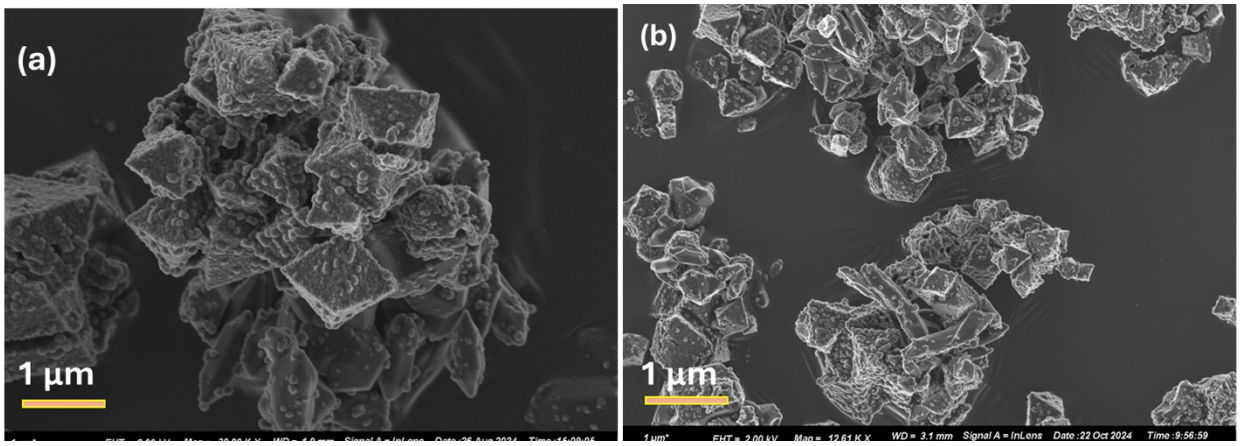


**Fig. S5**: SEM images of MIL-53(Fe)-Ni-2 (a) before and (b) after 10,000 cycling stability tests

## References


1. Cheng, H., Li, J., Meng, T. and Shu, D., 2024. Advances in Mn-Based MOFs and Their Derivatives for High-Performance Supercapacitor. *Small*, *20*(20), p.2308804.
2. Gopalakrishnan, A. and Badhulika, S., 2020. Effect of self-doped heteroatoms on the performance of biomass-derived carbon for supercapacitor applications. *Journal of power sources*, *480*, p.228830.