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CHOCOLATE COOKIES-LIKE BN@CO-C@C ENHANCING THERMAL CONDUCTIVITY AND MICROWAVE ABSORPTION OF POLYESTER-BASED COMPOSITE FILMS

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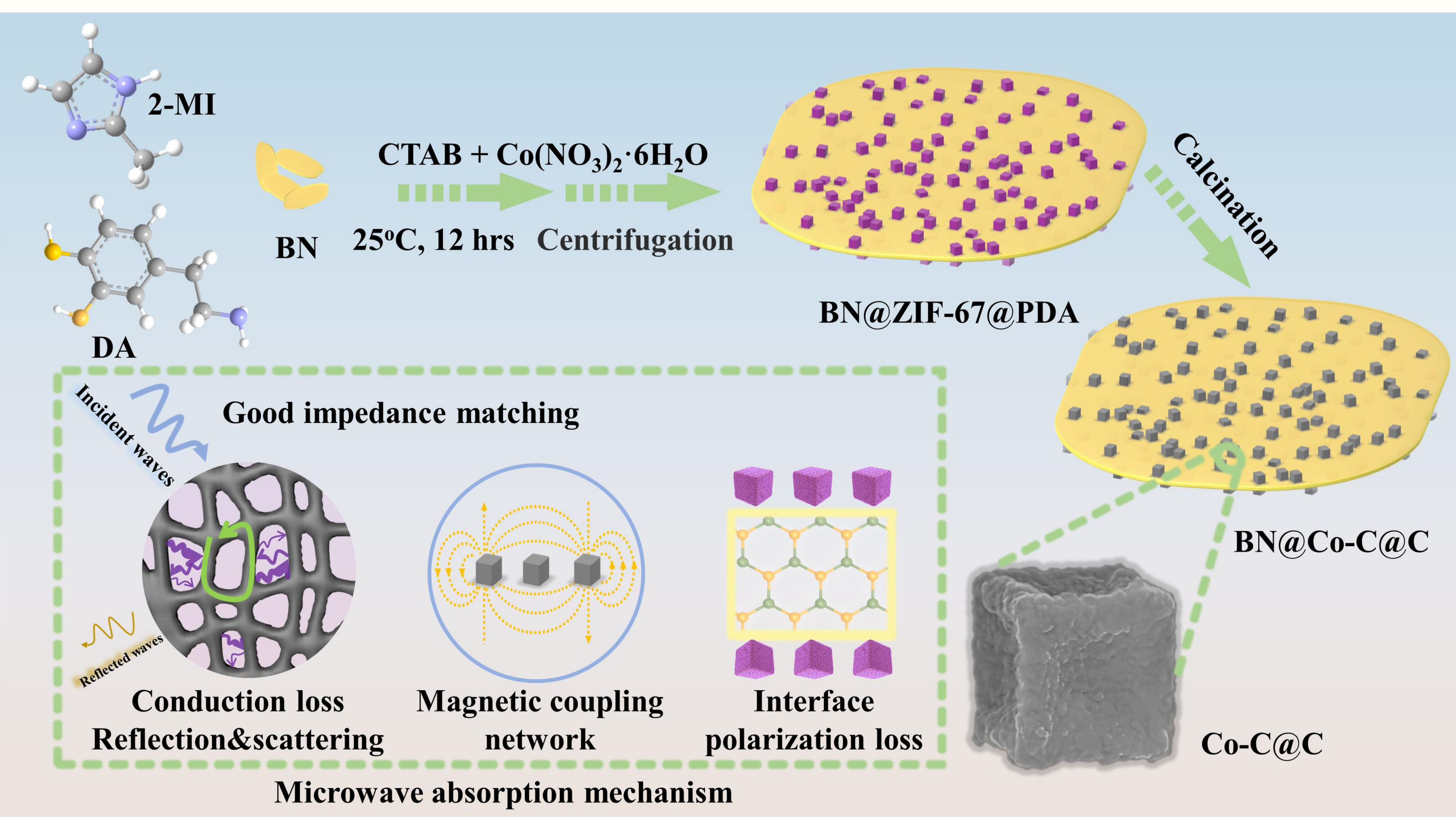
INTRODUCTION

- During the operation of electrical and electronic devices, the generated heat accumulates sharply and the generated electromagnetic wave would cause pollution to external environment. It is imperative to design and prepare thermally conductive & microwave absorbing composite materials.
- In this work, boron nitride (BN), with large surface area and excellent thermal conductivity (λ), is used to carry ZIF-67 through *in-situ* growth method, thus realizing synchronous improvement of thermal conductivity and microwave absorption.

EXPERIMENTAL SECTION



Scheme 1 Diagram for preparation and microwave absorption mechanism of BN@Co-C@C.

RESULTS: Structure and morphology

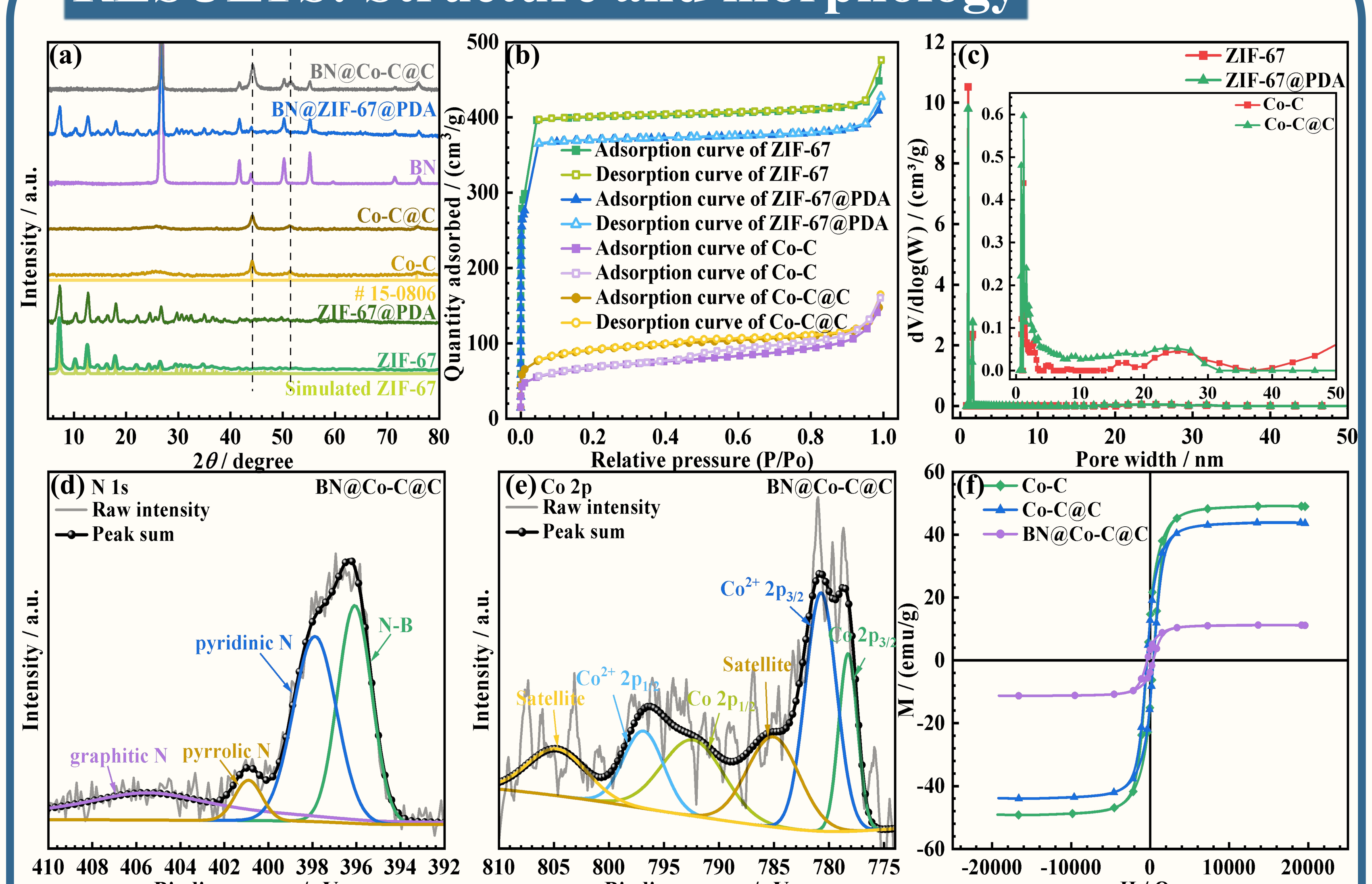


Figure 1 XRD patterns (a), N_2 adsorption-desorption isotherms (b), pore width distribution (c), XPS spectra (d, e) and hysteresis loops (f).

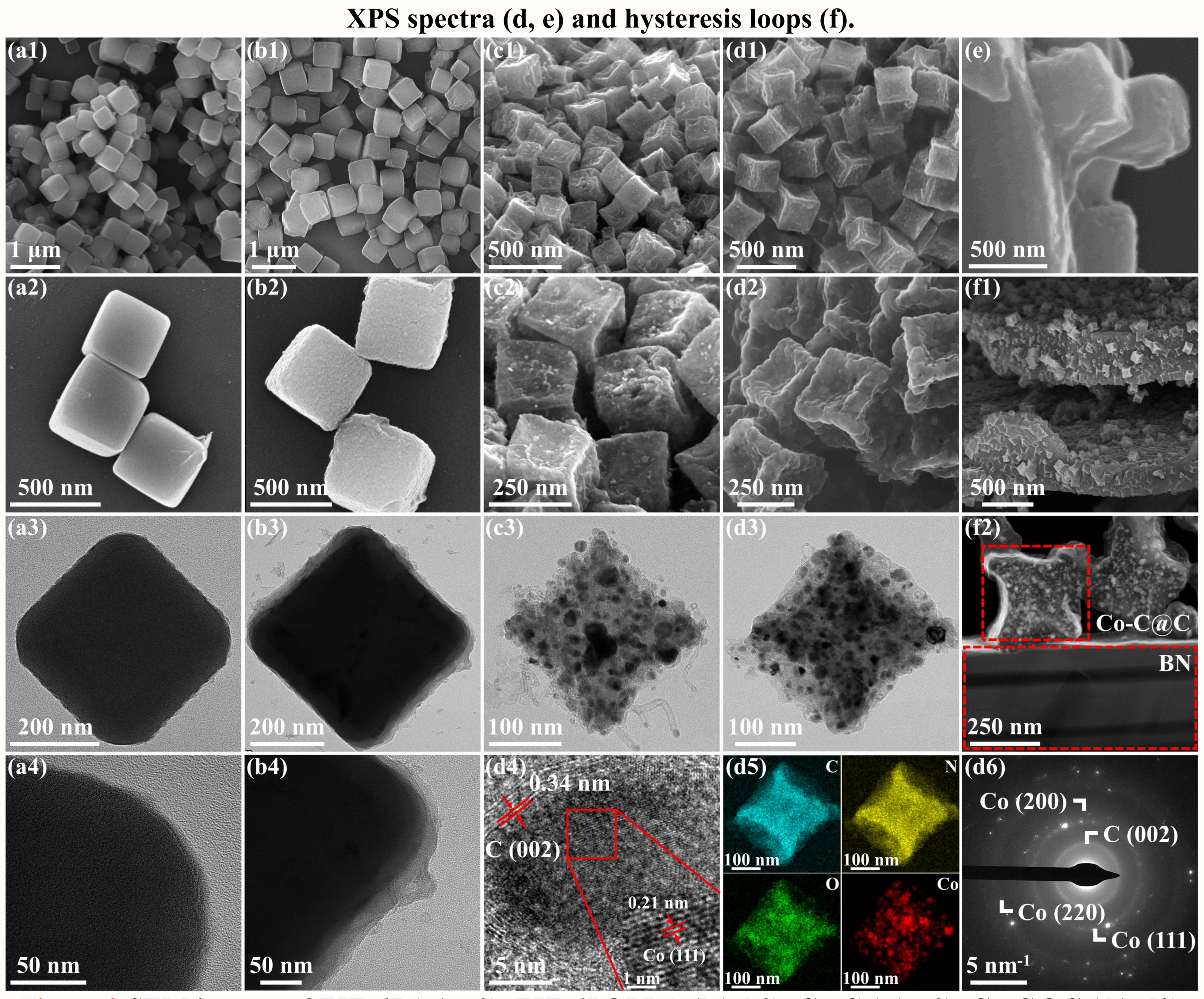


Figure 2 SEM images of ZIF-67 (a1, a2), ZIF-67@PDA (b1, b2), Co-C (c1, c2), Co-C@C (d1, d2), BN@ZIF-67@PDA (e) and BN@Co-C@C (f1); TEM images of ZIF-67 (a3, a4), ZIF-67@PDA (b3, b4), Co-C (c3), Co-C@C (d3) and BN@Co-C@C (f2); High-resolution TEM image (d4), element mapping (d5) and SAED image (d6) of Co-C@C.

RESULTS: Microwave absorption property

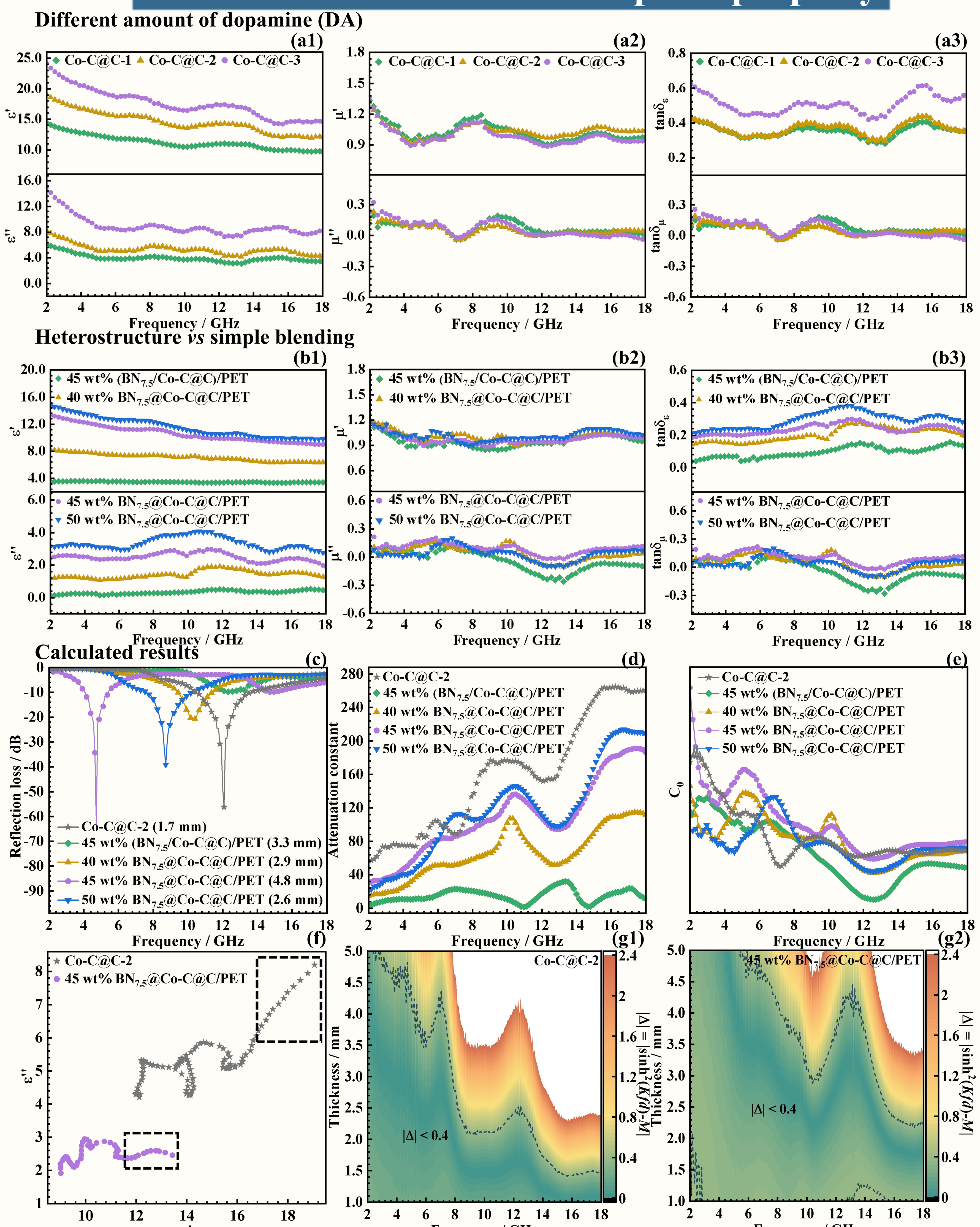


Figure 3 ε', ε'', μ', μ'', $\tan\delta_\varepsilon$ and $\tan\delta_\mu$ (a1-a3, b1-b3); RL_{min} (c), attenuation constant (d), C_0 (e), Cole-Cole curves (f) and the impedance matching (g1, g2).

RESULTS: Thermal conductivity

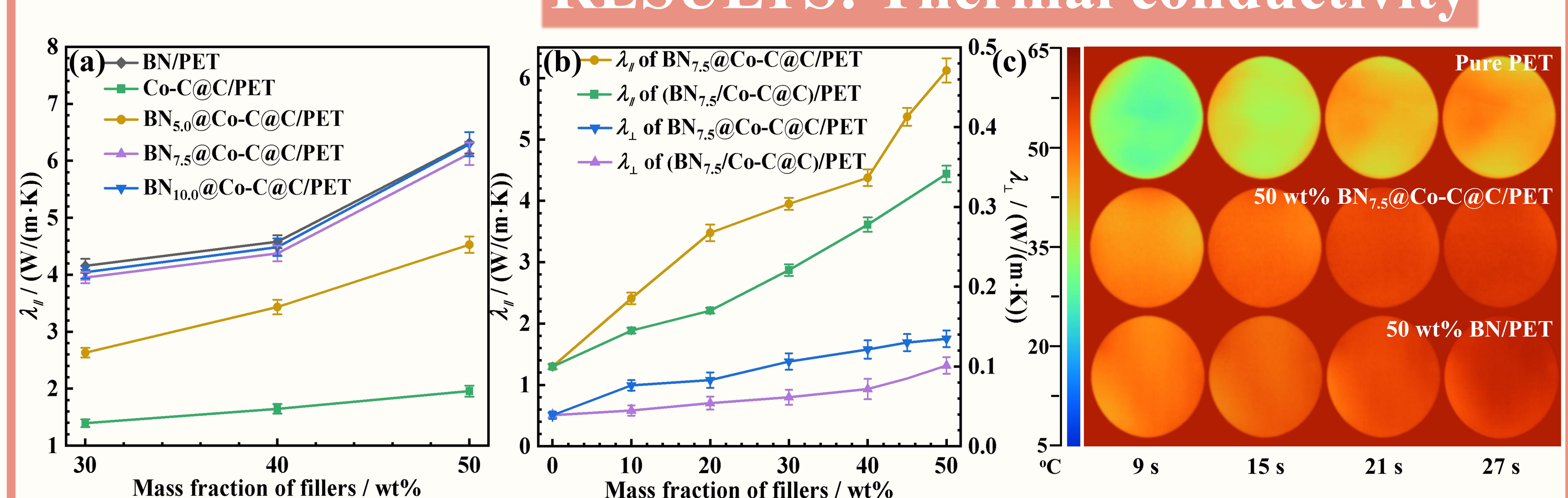


Figure 4 $\lambda_{/\!/}$, $\lambda_\perp$ (a, b) and infrared thermal images (c).

CONCLUSIONS

- The main microwave absorption mechanism of BN@Co-C@C:
  ①Co-C@C anchors on BN to create rich heterojunction interface and form C/Co-C/C/BN structure equivalent to series capacitor, thus producing strong polarization loss.
  ②The introduction of BN effectively regulates the $\tan\delta_\varepsilon/\tan\delta_\mu$ ratio, and achieves a better balance between impedance matching and attenuation constant.
- The results tested by coaxial method show that the minimum reflection loss (RL_{min}) of Co-C@C is -56.2 dB and the corresponding effective absorption bandwidth (EAB) is 3.04 GHz (10.48~13.52 GHz) with calculated thickness of 1.7 mm.
- When the theoretical mass ratio of BN and ZIF-67@PDA is 7.5:1 and the mass fraction of BN@Co-C@C is 45 wt%, RL_{min} and EAB of BN@Co-C@C/PET are -63.1 dB and 1.28 GHz (4.08~5.36 GHz) with calculated thickness of 4.8 mm, respectively.
- The corresponding in-plane thermal conductivity, glass transition temperature, heat resistance index, volume resistivity and tensile strength are 5.37 W/(m·K), 50.5°C, 130.4°C, 2.81×10^9 Ω·cm and 22.2 MPa, respectively.

PUBLISHED WORKS

X. Zhong, J. W. Gu*, et al. *Research*, 2022, 2022: 9805686.
X. Zhong, J. W. Gu*, et al. *Macromol Rapid Comm*, 2022, 43(1): 2100580.