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Self-Nitrogen-Doped Nanoporous Carbons Derived from Poly(1,5-diaminonaphthalene) for the Removal of Toxic Dye Pollutants from Wastewater: Non-linear Isotherm and Kinetic Analysis

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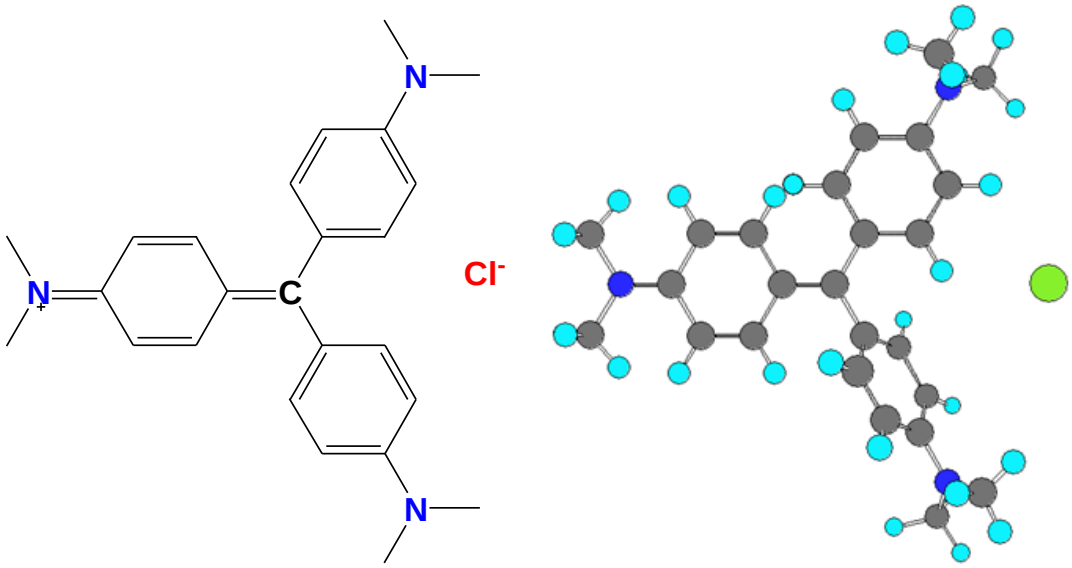

Figure S1: Chemical and molecular 3d structure of CV dye.

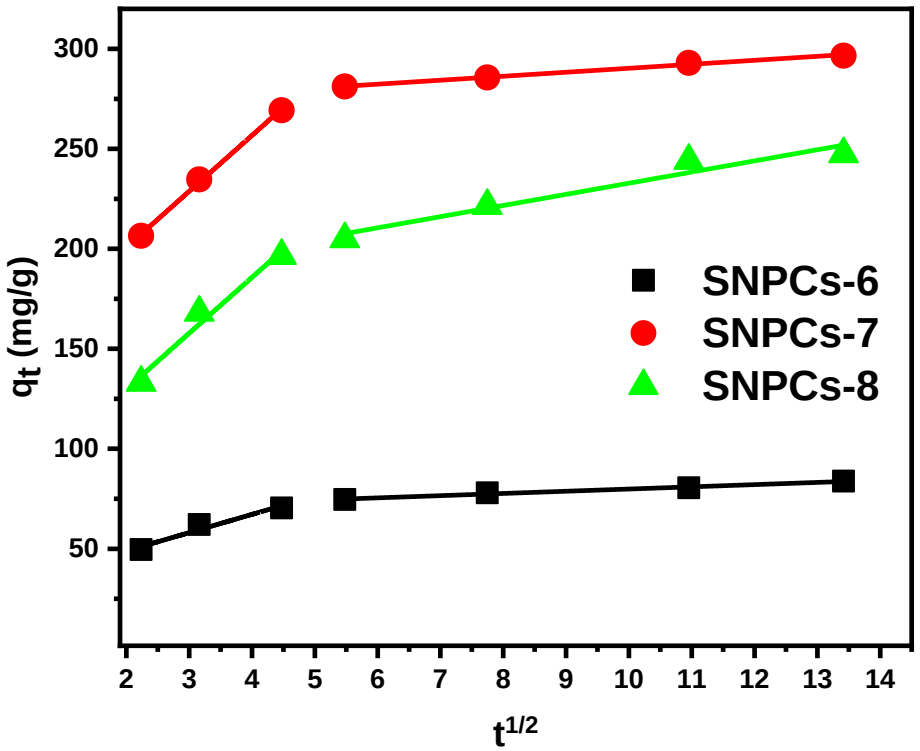

Figure S2: Intraparticle diffusion model of adsorption CV dye onto SNPCs.

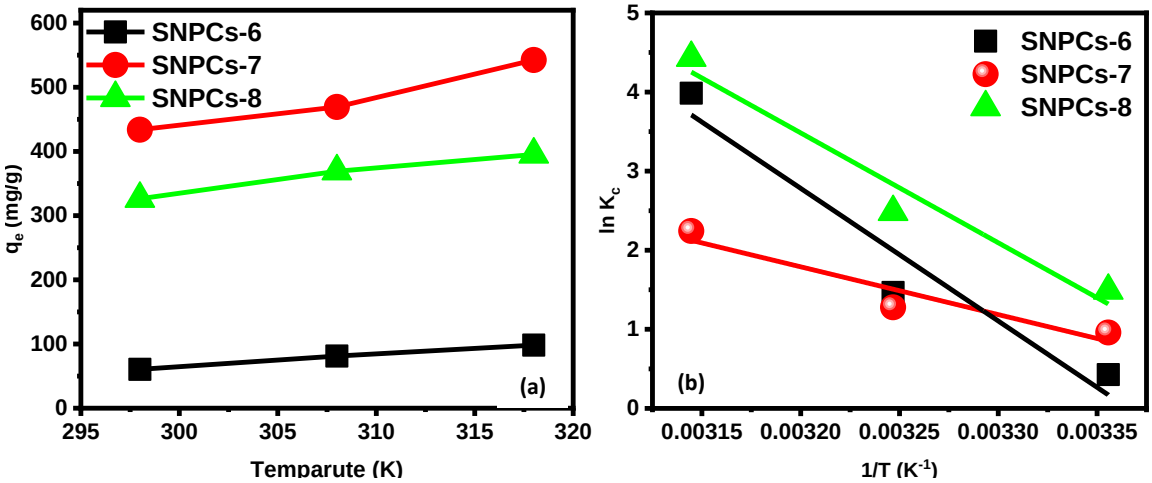

Figure S3: (a) Effect of temperature on adsorption of CV and (b) the plot between lnK_d versus $1/T$ for obtaining the thermodynamic parameters.

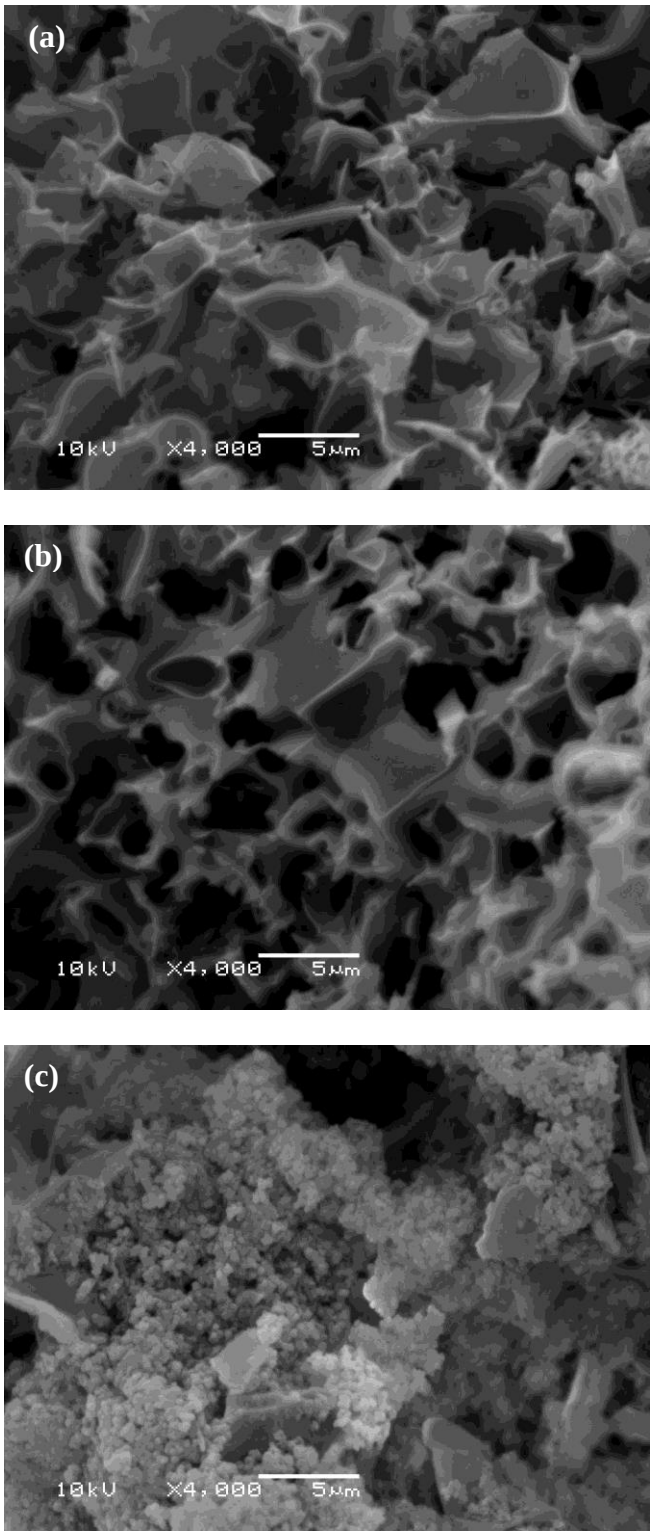

Figure S4: SEM images of (a) SNPCs-6 (b) SNPCs-6 (c) SNPCs-6 after adsorption CV dye.

Table S1. Description of adsorption isotherm models

Isotherm model	Equation	Parameters
Langmuir	$q_e = \frac{Q_o K_L C_e}{1 + K_L C_e}$	q_e (mg g^{-1}) = amount of dye adsorbed C_e (mg L^{-1}) = dye concentration at equilibrium Q_{omax} (mg g^{-1}) = maximum saturated monolayer adsorption capacity K_L (L mg^{-1}) = Langmuir constant
Freundlich	$q_e = K_f\ C_e^{1/n}$	K_F [(mg g^{-1})/(L mg^{-1})^n] = Freundlich constant n = Freundlich intensity parameter
Langmuir-Freundlich	$q_e = \frac{q_{max}\ (K_{LF} C_e)^m}{1 + (K_{LF} C_e)^m}$	$K_{L\text{-}F}$ (L mg^{-1}) = Langmuir-Freundlich constant q_{max} (mg g-1): the maximum binding capacity m: Langmuir-Freundlich isotherm exponen
Dubinin-Radushkevich	$q_e = q_o\ e^{-K_{D-R}\,\varepsilon^2}$ $\varepsilon = RTln(1 + \frac{1}{C_e})$ $E = \frac{1}{\sqrt{2K_{D-R}}}$	q_{DR} (mg g^{-1}) = adsorption capacity K_{DR} (mol^2 kJ^{-2}) = constant related to the sorption energy ε = Polanyi potential E (kJ mol^{-1}) = mean adsorption energy R (J mol^{-1}K^{-1}) = gas constant T (K) = absolute temperature.

Note: If E is between 8 and 16 kJ mol^{-1}, adsorption is achieved by chemical processes, whereas when E < 8 kJ mol^{-1} physical processes dominate.

Table S2. Description of adsorption kinetic models

Kinetic model	Equation	Parameters
Pseudo-first-order	$q_t = q_e(1 - e^{-K_1 t})$	q_t = amounts of dye adsorbed at time t q_e = amounts of dye adsorbed at equilibrium K_1 (min-1) = rate constant of the PFO
Pseudo-second-order	$q_t = \frac{q_2^2 k_2 t}{1 + q_e K_2\ t}$	K_2 (g mg^{-1} min^{-1}) = rate constant of PSO
Elovich	$q_t = \frac{1}{\beta}\ln(1 + \alpha\beta t)$	α (mg g^{-1} min^{-1}) = initial adsorption rate β (mg g^{-1}) = desorption constant during any one experiment
Intraparticle diffusion	$q_t = K_p\ t^{0.5} + C$	k_p (mg g^{-1} min$^{-1/2)}$ = represent the intraparticle diffusion rate constant C (mg g$_{-1}$) = constant related to the thickness of the boundary layer