



**FABRICATION AND CHARACTERIZATION OF
PAN/GO-ZnO NANOFIBERS WITH ENHANCED
MECHANICAL PROPERTIES AND ITS APPLICATION IN
WATER TREATMENT**

By

Eng. Mohamed Mahmoud Abdel Motaleb

A Thesis Submitted to the
Faculty of Engineering at Cairo University
In Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY

In

MECHANICAL DESIGN AND PRODUCTION ENGINEERING

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Title of Thesis:

Fabrication and characterization of PAN/GO-ZnO nanofibers with enhanced mechanical properties and its application in water treatment.

Key Words: Nanofibers; Graphene oxide; Electrospinning; Polyacrylonitrile; Tensile strength.

Summary:

Organic dyes and heavy metals are common water pollutants, which are frequently found in industrial effluents such as paper, plastic, stainless steel, cosmetic, textile and pharmaceutical industries. The widespread use of dyes in the different industrial area inevitably results in their unintended release into the environment, especially surface or groundwater, where they pose significant risks to both human and ecological systems. Not only do water bodies become colored, but also environmental damage occurs by decreasing the dissolved oxygen capacity and blocking sunlight, which results in significant environmental pollution impact on human and animal health

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the reference section.

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Nomenclature

A	Absorbance	A
A_T	Temkin constant	L/g
B_e	Berry number	
b_T	Temkin constant related to the heat of adsorption	kJ/mol
C	Initial concentration of solution after irradiation	mg/L
C_0	Initial concentration of solution before irradiation	mg/L
c_e	Chromium concentration in the at equilibrium	(mg/ L)
c_{id}	Intra-particle Diffusion rate intercept	
E	Elastic modulus	N/m ²
I	Intensity of the transmitted light	W/m ²
I_0	Intensity of the incident light	W/m ²
l	Distance that lights travels through the solution	cm
k_a	First-order rate constant	min ⁻¹
k_1	Linear pseudo first order adsorption constant	min ⁻¹
k_2	Linear pseudo-second-order rate constant of adsorption	g/mg min
k_3	Rate constant of nonlinear pseudo first order adsorption	min ⁻¹
k_4	Rate constant of nonlinear pseudo second order	g/mg min
k_L	Langmuir constant	L/mg
k_d	Thermodynamic equilibrium constant	L/mol
k_f	Freundlich constant	mg.g
k_{id}	Intra-particle Diffusion rate constant (mg/g/min ^{1/2})	mg/g/min ^{1/2}
m	Adsorbent dose	gm
n	Freundlich constant	
p_i	Load applied	N
p_{max}	Maximum load that the sample can carry	N
q_e	Adsorption capacities of Cr(VI) at equilibrium time	mg/g
q_m	Maximum adsorption capacity	mg/g

q_t	Adsorption capacities of Cr(VI) at time t		mg/g
R	Universal gas constant	8.314	J/mol/K
R^2	Correlation coefficients		
T	Transmittance		
T_a	Absolute temperature		K
t	Irradiation time interval		min
V	Total aqueous volume		L
σ_i	Tensile stress		N/m ²
σ_{max}	Maximum tensile strength		N/m ²
ε_a	Molar absorptivity		L/mol.cm
η	Degradation efficiency		
η_v	Intrinsic viscosity		dL/g
ΔH°	Enthalpy		J/Kg
ΔS°	Entropy		J/K