



ÓBUDA UNIVERSITY



Semester Report

Preparation and investigation of nanocomposites with polymer matrix

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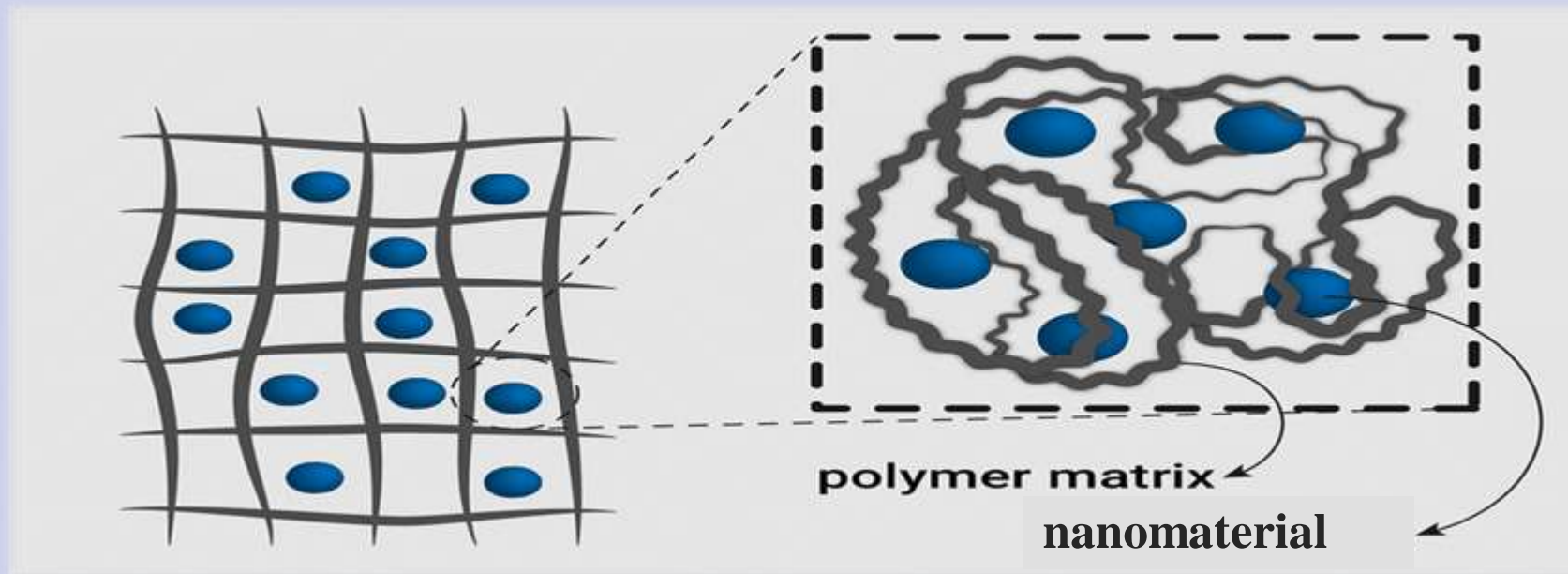
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Introduction

INTRODUCTION OF POLYMER NANOCOMPOSITES

- The polymer matrix composite when combine with nanomaterial as a dispersed phase is known as **Polymer nanocomposite**.
- In this at least one phase shows dimension in the **nanometer** range.
- The small particles have large surface area which causes improved interaction at phase interface which result in enhancement of the properties of nanocomposites.



IMPORTANCE

Small filler size:

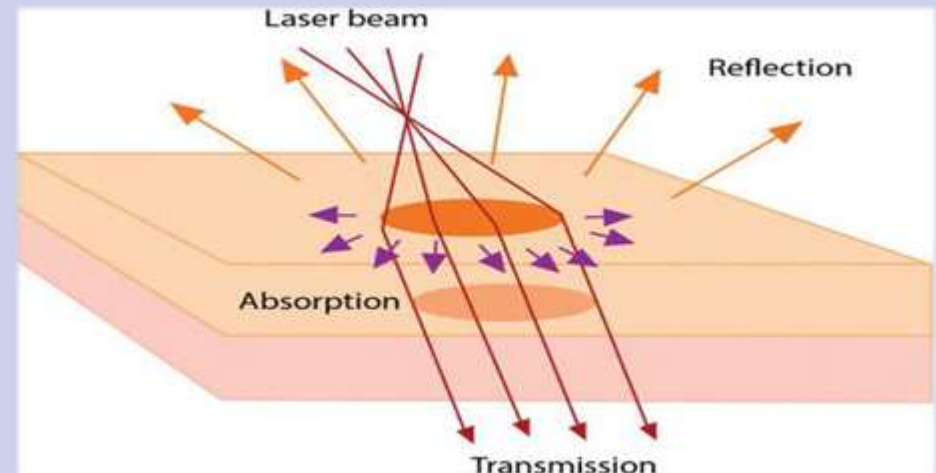
- High surface to volume ratio
 - . Small distance between fillers → bulk interfacial material
- Mechanical Properties
 - . Increased ductility with no decrease of strength
 - . Scratching resistance
- Optical Properties
 - . Light transmission characteristics depends on particle size



INTRODUCTION OF LASER

- A laser is a device that emits light (electromagnetic radiation) through a process of optical amplification based on the stimulated emission of photons.
- The term "laser" originated as an acronym for *Light Amplification by Stimulated Emission of Radiation*.
- Laser interaction with polymers:
There are three types of interactions that can occur between laser radiation and polymers.

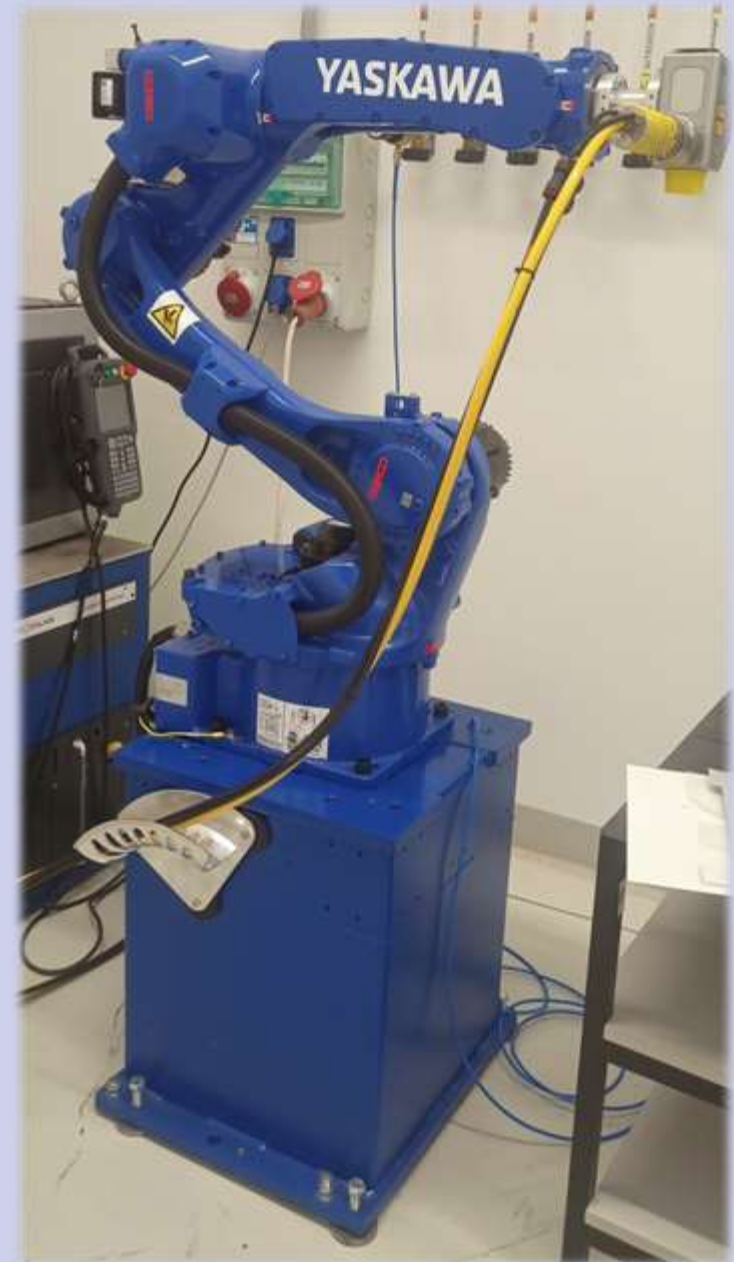
1. Reflection
2. Absorption
3. Transmission



- **Laser sources**

The types of lasers used for of polymers interactions includes:

1. **Carbon dioxide lasers**
2. **Solid-state lasers**
3. **Diode lasers**
4. **Fiber lasers**



Literature Review

Effect of Laser on Carbon nano-tubes /Poly Vinylalcohol Composite used in Microwave Shielding (Gamal M. Nasr, Ashraf S. AbdelHaleem, et al)

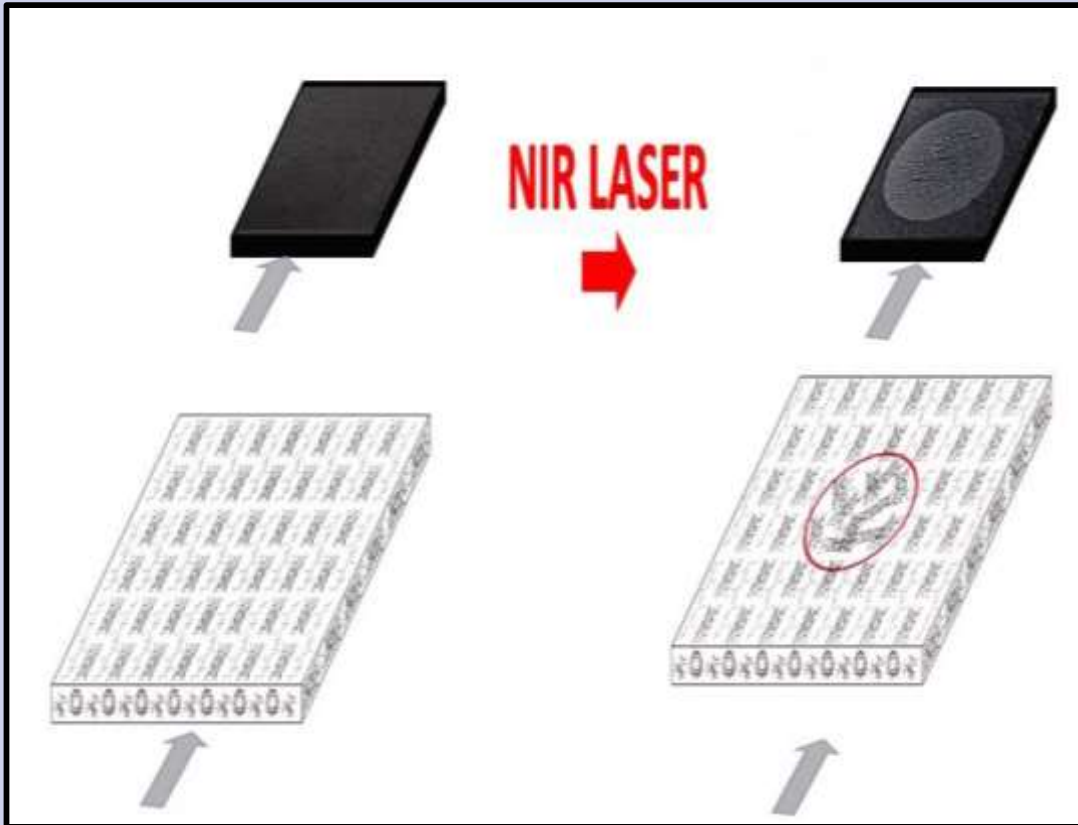
- PVA/CNT composite were prepared by the Solution mixing.
- Laser treatment is performed using CO₂-pulsed laser (Lumonics 103-2) with the wavelength of 9225 nm.

Results and discussion:

- The percolation threshold was appreciably changes from 0.019 to 0.029 by laser beam energies up to 200 Joule.
- The skin depth decreases with the increasing of CNT (to 0.04 V. fraction) by approximately 400 times its initial value and increases by four-order of magnitude upon irradiated the samples by 200 Joule laser-beam.
- The maximum value of SE_T (129.5dB) is obtained (at 35 GHz) for the irradiated composite loaded with 0.038.

Near-Infrared Laser Direct Writing of conductive patterns at the surface of Carbon nanotubes polymer nanocomposites (Gerges El Haber et al)

- A NIR laser was used with the nominal power is 50 W. The wavelength is 808 nm, with a typical circular spot diameter of 0.8 cm.



Results and discussion:

- Surface conductivity measurements shows that the absence of conductivity, even for CNT levels above the percolation threshold.
- The strong absorption of MWCNTs in the NIR allows the polymer surface to be heated locally above the melting point.
- The mobility of the MWCNTs allows a random reorganization of the MWCNTs which creates conduction channels in the material.
- A **5 second** irradiation with a power density of 7 W/cm^2 is sufficient to increase the surface conductivity by more than 4 orders of magnitude.

Findings



Findings

A

The synthesis of CNTs/polymer composite with different polymer ratios.

B

Compatibility of polymer with laser.

C

Investigation of Structural and morphological changes.

Solution for findings



Solutions

A

- With the help of literature find proper matrix(PP,PC, and PBT) and dispersed(MWCNTs) phase.

B

- Polymer nanocomposites with high energy absorption coefficients.
- Select suitable laser, wavelength and power.

C

- By using instrumental techniques such as DSC, TGA, FTIR and SEM.

Semester Activities

Semester activities

➤ I have taken the two courses:

* **“Structure of polymers”** with Dr. Andrea Ádámné Major

* **“Investigation of plastics and plastics composite”**

With Dr. Andrea Ádámné Major

➤ I have participated in two conferences: Oral presentation

* Agteco: 24.11.2022

* Obuda: “Fiatal Diplomások Fóruma 2022” on 10.12.2022

Future outlook

FUTURE OUTLOOK

- **Research**

- Laser irradiation significantly changes the **properties** of polymers.
- The addition of MWCNTs with polymer composites enhances their properties in the presence of a laser.
- PP, and PVA nanocomposites shows goods results in presence of laser.

- **Publication**

- Review article until March,2023.



Thanks for your Attention