

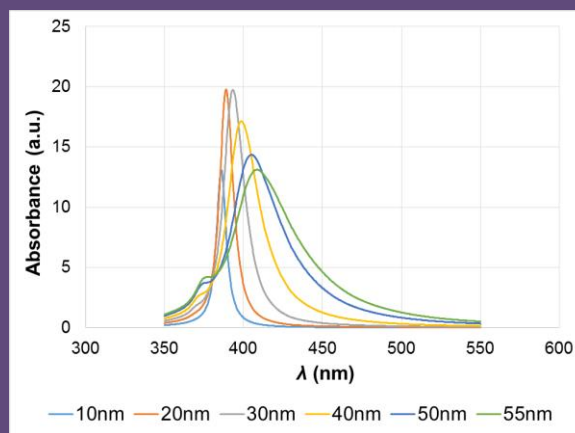
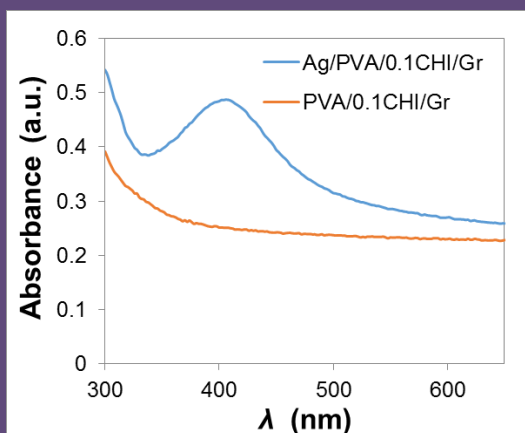
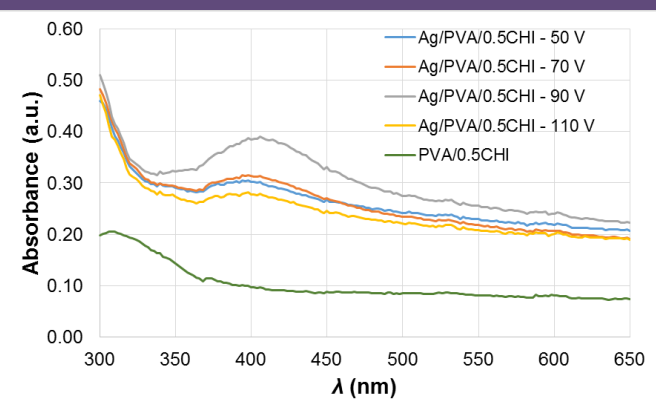
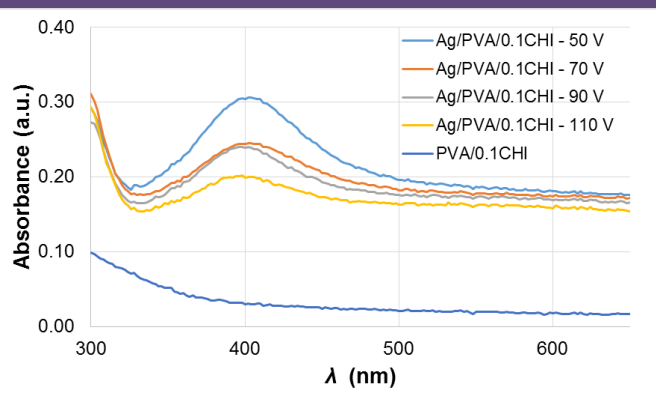
Marko Opsenica, Katarina Nešović, Vesna Mišković-Stanković  
University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia

## Introduction

- Hydrogels are biocompatible non-toxic materials with great sorption and controlled release capabilities
- Poly(vinyl alcohol) (PVA) is a biocompatible synthetic polymer that can form highly elastic hydrogels
- Chitosan (CHI), a natural polymer, besides its antibacterial activity, is often used as a drug carrier
- Graphene (Gr) provides mechanical support and improves thermal stability
- Silver nanoparticles (AgNPs), with their antibacterial and antifungal activity, can be incorporated inside synthesized hydrogels

## UV-vis spectroscopy

- UV-vis spectra of Ag/PVA/0.1CHI, Ag/PVA/0.5CHI and Ag/PVA/0.1CHI/Gr hydrogels were recorded in the wavelength range 300-650 nm
- Maximum absorbance ( $\lambda_{max}$ ) originating from AgNPs was found at ~400 nm

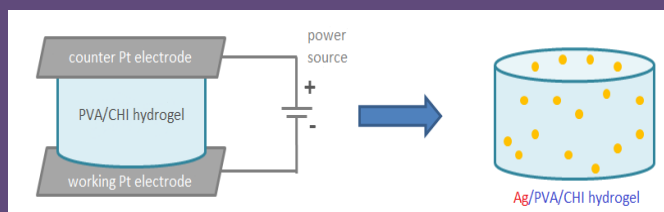


## Conclusions

- Ag/PVA/0.1CHI, Ag/PVA/0.5CHI and Ag/PVA/0.1CHI/Gr hydrogels were synthesized by applying different voltages (50 V, 70 V, 90 V and 110 V)
- Maximum absorbance on UV-vis spectra of Ag/PVA/0.1CHI, Ag/PVA/0.5CHI and Ag/PVA/0.1CHI/Gr hydrogels was found at  $\lambda_{max} \approx 398-406$  nm
- Impact of AgNPs diameters on  $\lambda_{max}$  was simulated via MiePlot program
- The optimal voltages for the AgNPs synthesis were 50 V and 90 V

## Electrochemical synthesis

- PVA/0.1CHI, PVA/0.5CHI and PVA/0.1CHI/Gr hydrogels were obtained by freezing-thawing method and swollen in  $\text{AgNO}_3$  and  $\text{KNO}_3$  solutions
- Electrochemical synthesis of AgNPs was performed at different voltages: 50 V, 70 V, 90 V and 110 V



## Simulation of UV-vis spectra

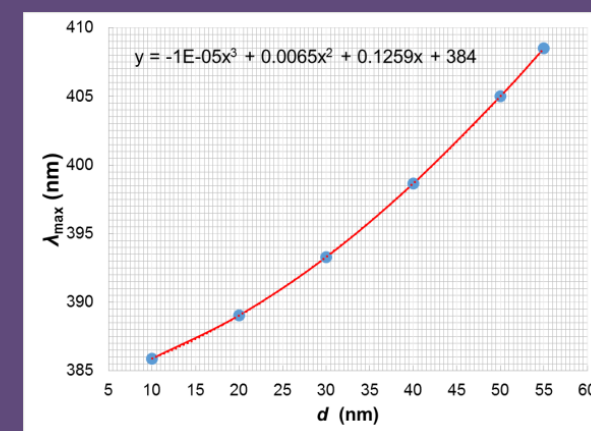
- The impact of AgNP diameter on the  $\lambda_{max}$  in UV-vis spectra was simulated via MiePlot program
- The absorbance values were simulated in the wavelength range 350-550 nm, depending on diameter of nanoparticles and the refractive index of the surrounding medium

## Refractive index

- Abbe refractometer was used to measure refractive index of dissolved hydrogels at 25° C and 589.3 nm wavelength
- The refractive indices were also calculated for the investigated wavelength range (350-550 nm)

## Determination AgNPs diameters

- Based on simulation results,  $\lambda_{max} = f(d)$  calibration curve was constructed
- Diameters of nanoparticles in hydrogel samples were determined based on these results



- Criteria for optimization is diameter of AgNPs, and the value of the maximum absorbance
- The optimal voltages for incorporation of AgNPs were determined to be 50 V and 90 V

Sample	U (V)	$A_{max}$	$\lambda_{max}$ (nm)	d (nm)
Ag/PVA/0.1CHI	50	0.2763	404	48.5
Ag/PVA/0.1CHI	70	0.2152	404	48.5
Ag/PVA/0.1CHI	90	0.2095	402	45.5
Ag/PVA/0.1CHI	110	0.1701	406	51.5
Ag/PVA/0.5CHI	50	0.2058	398	39.0
Ag/PVA/0.5CHI	70	0.2173	406	51.5
Ag/PVA/0.5CHI	90	0.2928	406	51.5
Ag/PVA/0.5CHI	110	0.1825	406	51.5
Ag/PVA/0.1CHI/Gr	90	0.2368	406	51.5

## References

- K. Nešović, A. Janković, T. Radetić, M. Vukašinović-Sekulić, V. Kojić, Lj. Živković, A. Perić-Grujić, K.Y. Rhee, V. Mišković-Stanković, *European Polymer Journal* 121 (2019) 109257.
- P. Laven, „MiePlot, A computer program for scattering of light from a sphere using Mie theory & the Debye series“, <http://www.philiplaven.com/mieplot.htm>