

Seliverstova E., Serikov T., Sadykova A., Ibrayev N.

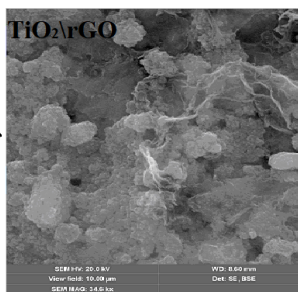
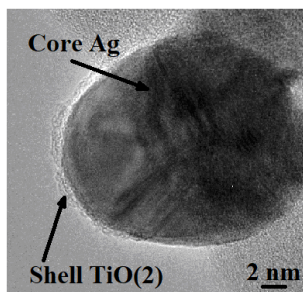
Institute of Molecular Nanophotonics, Buketov Karaganda University, Karaganda, Kazakhstan, genia_sv@mail.ru

Titanium dioxide (TiO₂), due to its physicochemical properties, is one of the most accessible and attractive photocatalysts. In order to improve its photocatalytic properties, nanocomposite materials with graphene derivatives are synthesized. The problem of limited absorption of TiO₂ in the visible region can be solved by addition of metal nanoparticles (NPs) with localized plasmon resonance effect. The nanocomposite was obtained by hydrothermal synthesis. Ag/TiO₂ nanostructures are consisted of Ag NPs with an average diameter of 26 nm and a TiO₂ shell of 10 nm thick were added to the prepared nanocomposite at concentrations of 0.1, 0.3 and 0.5 wt%.

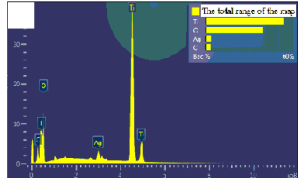
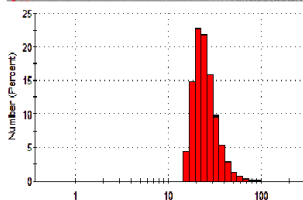
The photocatalytic activity of the samples was evaluated by measuring the magnitude of the photoinduced current in a standard three-electrode cell using a CS350 potentiostat/galvanostat with the determination of an EIS analyzer (Corrtest Instr.).

TEM image of Ag/TiO₂ nanostructure

SEM image of TiO₂ and reduced graphene oxide nanocomposite



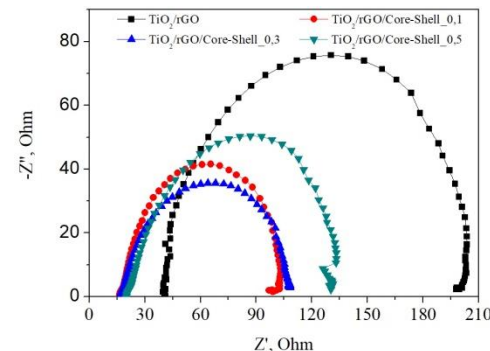
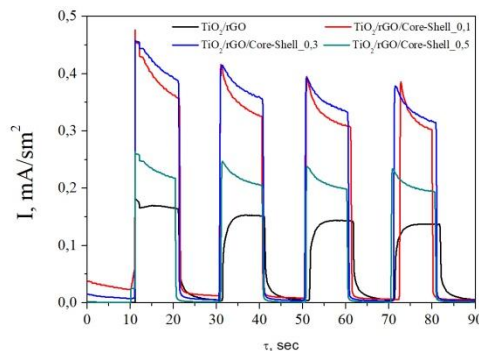
0.1 wt%
0.3 wt%
0.5 wt%



Size distribution of Ag/TiO₂ nanostructures

EDX analysis of TiO₂/rGO nanocomposite

Photocurrent and impedance spectra of TiO₂/rGO nanocomposite at various concentration of core/shell nanostructures



Measurements have shown that the presence of Ag/TiO₂ nanostructures leads to the increase in photocurrent values in 2.8 times compared to films without plasmon NPs. The highest values were recorded for TiO₂/rGO films with an Ag/TiO₂ concentration of 0.3 wt%.

From the impedance spectroscopy data (potential/galvanostat CS350, Corrtest Instr.), it was found that nanocomposite films doped with Ag/TiO₂ have a lower values of resistance to charge carrier transport, as well as resistance associated with recombination processes. In addition the lifetime of charge carriers was increased in the presence of plasmon NPs.

Electrophysical parameters of TiO₂/rGO nanocomposite at various concentration of core/shell nanostructures

| Sample | Rs, Ohm | CPE-T | CPE-P | Rp, Ohm | ω, Hz | τ, s |
|--|---------|----------------------|-------|---------|-------|--------|
| TiO ₂ /rGO | 37.20 | 1.1*10 ⁻⁵ | 0.90 | 205.0 | 127.8 | 0.0078 |
| TiO ₂ /rGO+ Ag/TiO ₂ , 0.1 wt% | 17.81 | 2.0*10 ⁻⁵ | 0.83 | 91.7 | 295.9 | 0.0033 |
| TiO ₂ /rGO+ Ag/TiO ₂ , 0.3 wt% | 17.54 | 2.6*10 ⁻⁵ | 0.87 | 89.0 | 146.9 | 0.0068 |
| TiO ₂ /rGO+ Ag/TiO ₂ , 0.5 wt% | 22,28 | 1.6*10 ⁻⁵ | 0.86 | 118.7 | 194.6 | 0.0051 |