Investigation of TiO$_2$/graphene Nanocomposite for Cancer Photothermal Therapy

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Cancer is one of the leading causes of death worldwide. Furthermore the number of deaths is increasing every year. Conventional methods such as surgery, chemotherapy and radiation therapy could cause side effects such as infection, toxicity to the body, and damages of neighboring healthy cells. Recently, photothermal therapy has been receiving great attention due to its high potential and less side effects. This method utilizes an agent to absorb light in near infrared (NIR) wavelengths and convert to heat in order to kill cancer cells or tumors. In this work, the efficacy of TiO$_2$/graphene nanocomposite as photothermal therapy agent has been investigated. The TiO$_2$/graphene nanocomposite was prepared by tagging graphene oxide on TiO$_2$ nanoparticles using hydrothermal process. The bonding of Ti-O-C could narrow the band gap of titanium leading to higher absorption efficiency of the nanocomposite at visible and NIR wavelengths. In the temperature measurement of 2 agents: TiO$_2$/graphene and TiO$_2$ in water under NIR exposure (wavelength of 808 nm), TiO$_2$/graphene was found to raise the water temperature to higher temperature than TiO$_2$ did. Furthermore, the experiment with HepG2 cancer cells revealed that TiO$_2$/graphene nanocomposite at a concentration of 1 mg/mL was not toxic to cells but could kill cancer cells significantly better than TiO$_2$ nanoparticle did when exposed to a NIR laser with an intensity of 4 W/cm^2 for 20 mins.
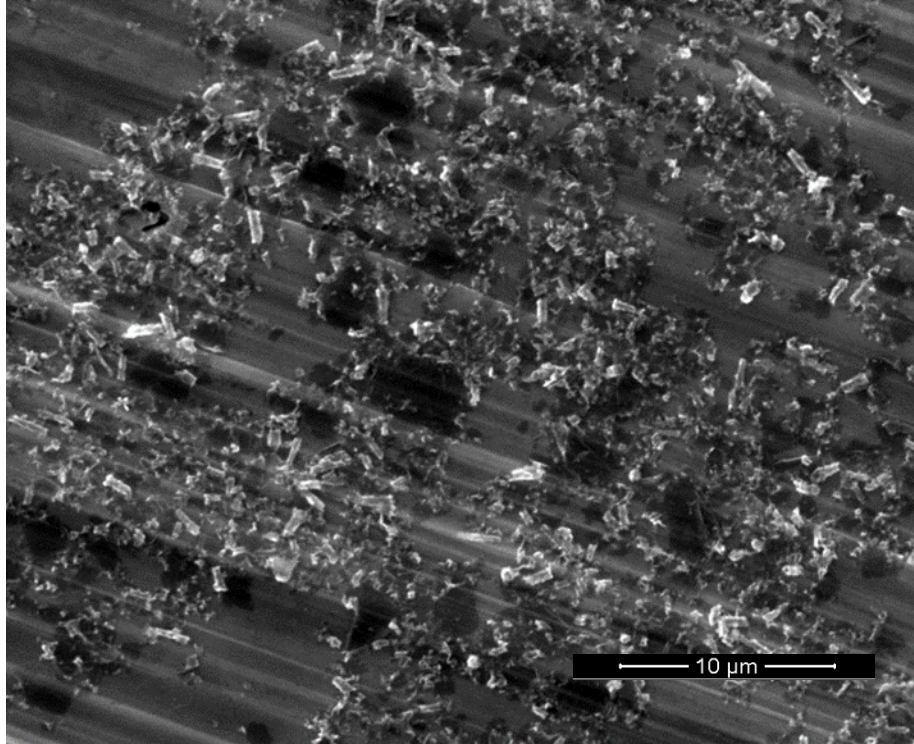
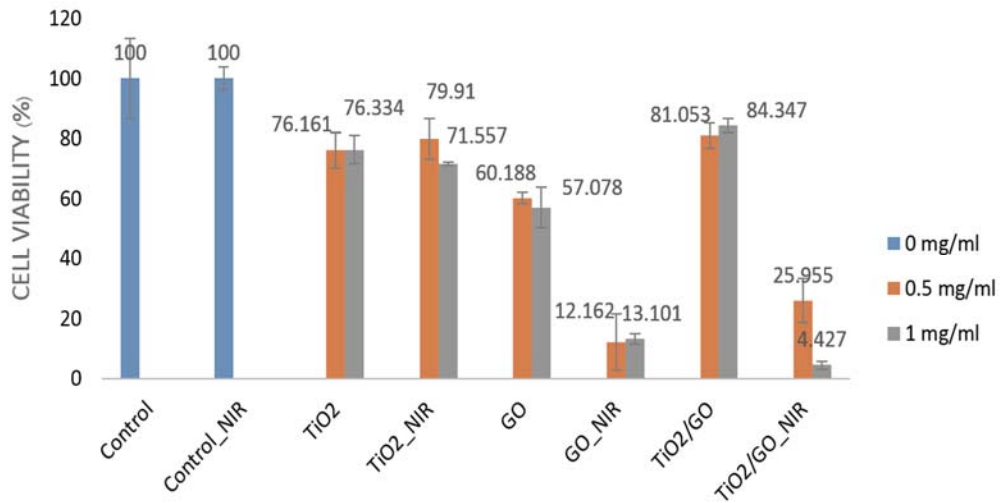*Figure 1:* The SEM micrograph of TiO2/graphene nanocomposite

Figure 2: The cell viabilities of the HepG2 cells when treated with various agents: Control (cells without agent nor NIR exposure), Control_NIR (cells treated with NIR exposure), TiO2 (cells treated with TiO2), TiO2_NIR (cells treated with TiO2 and NIR exposure), GO (cells treated with graphene oxide), GO_NIR (cells treated with GO and NIR exposure), TiO2/GO (cell treated with TiO2/graphene) and TiO2/GO_NIR (cells treated with TiO2/graphene and NIR exposure).