Among the various semiconductors, TiO$_2$ is considered to be an almost ideal photocatalyst since it is relatively inexpensive, chemically stable and its photogenerated holes are highly oxidizing. In this context, nanostructured TiO$_2$ has been playing an increasing role in photocatalytic applications where crystal structure, size (surface area) and shape (exposed surfaces) are important. In particular, anatase has been proven to show the best performance among all the TiO$_2$ crystallographic phases.

Photodegradation of polymers has been gaining attention as a useful way to decompose solid polymers in open air and avoid environmental pollution. Encouraging results have been reported in the literature for the photodegradation of nanocomposite plastic films containing TiO$_2$ and polymeric matrices. However, there is no report on the evaluation of the effect of TiO$_2$ nanoparticles morphology on the photodegradation of nanocomposite plastic films containing TiO$_2$.

In the present work TiO$_2$ nanocrystals were synthesized starting from hydrogen trititanate nanotubes (H-TTNT), obtained by the alkaline hydrothermal method. The H-TTNT material was submitted to thermal treatments at 550°C, 650°C and 750°C for 2 h and analyzed by means of X-Ray Diffraction and Transmission Electron Microscopy. Four nanocomposite films were produced with polyethylene matrix and 5% of TiO$_2$ based nanomaterial: H-TTNT treated at 550°C, 650°C, 750°C and commercial TiO$_2$ P-25. It was also produced pure polyethylene films for comparison. The photodegradation of these films was evaluated by means of measuring the weight reduction under UV radiation. The films containing P-25 and H-TTNT treated at 550°C showed the highest degradation rate. H-TTNT treated at 550 and 650°C contain only anatase while H-TTNT treated at 750°C exhibited ~8% of rutile, determined by Rietveld refinement of XRD results. H-TTNT treated at 550°C showed mainly nanorods (Fig.1) with diameters below 10nm while H-TTNT treated at 750°C contains particles in the range of 20 to 100nm and many particles with the anatase equilibrium crystal shape (Fig. 2). The higher performance for polymer degradation observed for nanocomposites containing H-TTNT treated at 550°C was tentatively attributed to the nanorods high energy surface facets.

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Fig. 1: H-TTNT heat treated at 550°C.

Fig. 2: H-TTNT heat treated at 750°C.