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Engineered Nanoporous Anodic Alumina Micro and Nanoparticles for Biomedical Applications

Nanometric and micrometric particles have attracted great interest in recent years due to their interesting features for the development of biomedical applications with great social impact [1,2]. Particles that respond to variables in specific tissues in the human body are a novel and promising strategy in health care and quality of life. Recent studies have presented excellent results using particles in the micrometric and nanometric size range in vitro and in vivo [3].

Nanoporous anodic alumina (NAA) is a nanostructured material, excellent for the formation of these particles. NAA consists of hexagonally-ordered straight nanometric pores arranged in an alumina matrix. Its geometric characteristics (pore size, interpore distance, porosity, and thickness) can be molded by the anodization conditions (voltage and time of anodization, temperature, and acid used as electrolyte), with a cost-effective and precise control fabrication [4,5]. Its high effective surface area (hundreds of m^2/cm^3) can be chemically modified with organic compounds [3]. The physical, chemical and optical properties of NAA together with its nontoxicity and its highly stable morphology in buffer solutions makes of NAA an interesting material for the development of particles for biological applications [6]. Another singular characteristic that distinguishes NAA particles from particles made of other materials is their inherent photoluminescence in the visible spectrum range (Figure 1). Besides, its compatibility with biological tissues has been demonstrated with its use in orthopedic prosthetics, dental and coronary stents, cell culture scaffolds, and immunoisolation devices [7].

In this work, we present different NAA particles with a micrometric and nanometric size and we study and evaluate their physical, chemical and optical properties for a wide range of applications in the biomedical and biotechnological fields.

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References

[1] E. Xifre-Perez, J. Ferre-Borull, J. Pallares, L.F. Marsal, Mesoporous Biomater., 2 (2015).

[2] M. Alba, B. Delalat, P. Formentín, M.-L. Rogers, L.F. Marsal, N.H. Voelcker, Small, 11 (2015), 4626.

[3] E. Xifre-Perez, S. Guaita-Esteruelas, M. Baranowska, J. Pallares, L. Masana, L.F. Marsal, ACS Appl. Mater. Interfaces, 7 (2015) 18600.

[4] A. Santos, P. Formentín, J. Ferré-Borrull, J. Pallarès, L.F. Marsal, Mater. Lett. 67 (2012) 296-299

[5] L.F. Marsal, L. Vojkuvka, P. Formentin, J. Pallarés, J. Ferré-Borrull, Opt. Mater. 31 (2009) 860.

[6] A. Santos, M. Alba, M.M. Rahman, P. Formentin, J. Ferre-Borrull, J. Pallares, L.F. Marsal, Nanoscale Res. Lett. 7 (2012) 228.

[7] E. Gultepe, D. Nagesha, S. Sridhar, M. Amiji, Adv. Drug Deliv. Rev. 62 (2010) 305.

Figures

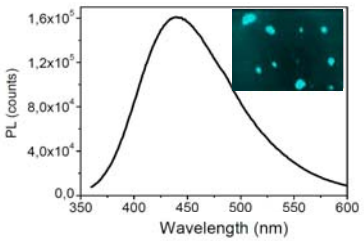

Figure 1: Photoluminescence of NAA particles (excitation wavelength 340 nm). Inset: Blue fluorescence field image of NAA particles.