

Chapter 18

The Use of Polymer Nanocomposites in the Aerospace and the Military/Defence Industries

Emmanuel Rotimi Sadiku

Tshwane University of Technology, South Africa

Oluranti Agboola

Covenant University, Nigeria

Mokgaotsa Jonas Mochane

Tshwane University of Technology, South Africa

Victoria Oluwaseun Fasiku

University of Kwazulu Natal, South Africa

Shesan John Owonubi

University of Zululand, South Africa

Idowu David Ibrahim

Tshwane University of Technology, South Africa

Babul Reddy Abbavaram

Tshwane University of Technology, South Africa

Williams Kehinde Kupolati

Tshwane University of Technology, South Africa

Tippabattini Jayaramudu

Universidad de Talca, Chile

Chukwunonso Aghaegbulam Uwa

Tshwane University of Technology, South Africa

Oluyemi Ojo Daramola

Federal University of Technology Akure, Nigeria & Tshwane University of Technology, South Africa

Nnamdi Chibuikwe Iheaturu

Federal University of Technology Owerri, Nigeria

Clara Nkuna

Tshwane University of Technology, South Africa

Samuel Eshorame Sanni

Covenant University, Nigeria

Olusesan Frank Biotidara

Yaba College of Technology, Nigeria

Azunna Agwo Eze

Tshwane University of Technology, South Africa

Kokkarachedu Varaprasad

Centro de Investigacion de Polimeros Avanzados (CIPA), Chile

Oladimeji Adetona Adeyeye

Tshwane University of Technology, South Africa

Koena Mantsopa Selatile

Tshwane University of Technology, South Africa

Abongile Sinawo Ndamase

Tshwane University of Technology, South Africa

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ABSTRACT

Previously, applications of composites were limited to the military aerospace. This is because civilian aircraft with composites inclusions was considered to be too expensive. The use of composite in aircrafts, instead of steel, has resulted in lightweight aircraft structures and has consequently reduced the level of fuel consumption and costs of fuel, thereby reducing CO₂ emissions. Undoubtedly, nanocomposites applications abound in several aspects of human life and the use of nanoparticle in materials dates back to the understanding of the nature of these materials. This chapter will focus on the use of nanopolymers in the aerospace and in the military. Particular attention will be given to nano military weapons, nanocoating for military applications, nanotechnology for military drones, nanotechnology in military suits, gloves, boots and nanotechnology in armored military vehicles, aircraft, and military ships and in military medicine.

INTRODUCTION

In many aspects of human life, nanotechnology plays a crucial role and the enabling advances in defence technologies are simply staggering, even though some of the opportunities may not likely to be realised in the next few decades. However, currently, many advantages are being realized and more explorations are in steady progress, particularly for defence and aerospace applications. An insight into the capabilities offered by nanocomposites in general and polymer nanocomposites in particular in the aerospace and defence industries, which includes: smart materials, light and hard materials, fuel sources and storage and protective devices, will be highlighted in this chapter. It will discuss polymer-based nanocomposite materials, nanoscale fillers and the potential use of nanocomposite materials in the aerospace and defence sectors, with practical examples, where appropriate. In the past, composites were used, mainly in military aerospace applications. Nowadays, composites find applications in civilian aviation and in the military aerospace. This was because, the manufacture of civilian aircrafts with composites was considered, rather too expensive and should composites be a part of their design; they were then used, typically, for non-structural applications. However, when the civilian aircraft industry needed to respond to the rising cost of oil and pressures due to environmental concerns, this had to change for materials of comparative high strength and lighter weight.

There are recent developments in aircraft design, which can obviously be noticeable in the Airbus A380, Bombardier C-series and of course, the Boeing B787 airliners. These developments have led to a phenomenon rise in the use of composites, which has also led to a corresponding increase in adhesive bonding of primary structures in aircraft. The aerospace industry is one of the, undeniably, foremost adopters of advanced composite materials, particularly composites reinforced with carbon fibre. This is so because of the industry demands for low-weight materials with high strength and stiffness. Of course, the ability to mould composite parts and components into curved and complex shapes, is highly important for military applications. Indeed, it can be safely argued that composites constitute at least a quarter (¼) of aircraft by weight, since the introduction of composites in the aerospace industry and polymer composites and polymer nanocomposites, adhesives and sealants, constitute a major part of these materials.

In their review work, Kurahatti et al. (2010) provided an insight into the various capabilities offered by nanocomposites. They discussed some polymer-based nanocomposite materials, nanoscale fillers and

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