Chapter 1
Introduction

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The term "smart" describes an intellectual concept that is associated with human behavior. However, the smart concept has been adapted to engineering materials by the technological developments in recent years [1]. A great interest from every sector has been devoted to gain smart properties for various materials that are used to produce smart components, structures, and systems. Smart materials are known as the engineered materials that have controlled behavior by the external stimulations. The controlled behavior can be related to one or more properties such as electrical, magnetic, chemical, physical, thermal, and mechanical [2]. Shear thickening is one of non-Newtonian behaviors widely seen in colloidal suspensions. Despite the smart properties of shear thickening behavior, it has been considered as a problem in the industrial applications for a long time. In the chemical and textile industries, mixers generally suffer from overloading-based failures, while spray nozzles encounter with blockage downtimes due to the shear thickening of suspensions [3]. Over the last two decades, researchers have made significant achievements about shear thickening and consequently benefitting from this non-Newtonian behavior in various engineering fields [4]. Shear thickening rheology has been investigated by many researchers to find out the main factors in a controllable fashion so that the smart concept has been obtained for shear thickening fluid (STF). A set of factors has been listed in recent publications regarding the controllable properties of STF. Upon understanding the shear thickening principles, STF has been adapted to several applications such as multi-functional systems, damping devices, protective structures, manufacturing operations, etc.

This book provides a comprehensive source on shear thickening rheology and STF applications for engineers, researchers, and scientists. The basics of STF rheology are given while discussing the determining factors on shear thickening

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behavior. In addition, a novel concept, namely multi-phase STF, is described. Multi-phase STF, which includes various filler materials in an STF, dates back to less than a decade ago; however, there have been an increasing number of attempts on this novel concept. For example, shear thickening properties are enhanced by using rigid fillers while conductivity is developed with conductive fillers in STF. In addition to rheological side, various applications are given in this book. Multi-functional systems have been widely investigated in recent years. Based on the desired multi-functional properties, multi-phase STF systems are designed by using proper filler materials. Furthermore, STF-based vibration damping devices are discussed with the help of a literature survey. Shear thickening rheology provides adaptive properties for damping systems, thereby ensuring the design of smart damping devices. Surface finishing processes also take advantage of shear thickening rheology to design effective polishing slurries and, therefore, STF-based surface processing is given in this book. Protective structures are the main application field for STF. There are several studies on STF-included protective systems to benefit from shear thickening rheology for designing flexible and lightweight structures. STF-based protective structures are discussed with two chapters in this book so that focusing on low and high velocity threats respectively.

References

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