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Editorial

Machinability and Tribological Performance of Advanced Alloys

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1. Introduction and Scope

Machining is specially utilized to manufacture special, precision parts and difficult-to-form materials. The most challenging aspects of this topic are the continuously evolving quality and productivity requirements in modern industries and creating new and smart materials that meet energy and environmental (green/clean) regulations. In general, among the conventional machining operations, high-end, modern material removal processes are addressed in this Special Issue (e.g., using high-energy beams, such as laser machining).

The tribological performance of alloys plays an important role in the production or service environment. Because it is closely related to their materials and manufacturing characteristics, it is considered to be a combined topic in the frame of this Special Issue. The study of tribological behaviour suitably addresses the surface engineering aspects of modern and conventional alloys, either in bulk or in coating form, and receives special attention in the generic context of industrial component production and/or service in aggressive working environments.

The core subject of this Special Issue is the elaboration and presentation of studies on alloy design, manufacturing, testing and characterization in order to provide a clear insight into their machinability and/or tribological behaviour. The improvement of these properties has led to the development of new alloy chemistries, novel engineered microstructures and the application of coatings that produce better machinability and/or tribological endurance properties under poor service conditions. Environmental and health and safety regulations demand the use of ecofriendly components. The manufacture of anti-microbial copper alloys in healthcare facilities and the elimination of lead in brass components for drinking water applications constitute examples of this modern industrial trend.

Altering the manufacturing and service conditions is also essential for achieving the optimization of their machinability and tribological performance. The application of surface processes to enhance the tribological performance of alloys is be addressed in this Special Issue.

Briefly, the main machinability parameters and outcomes are schematically depicted in Figure 1.

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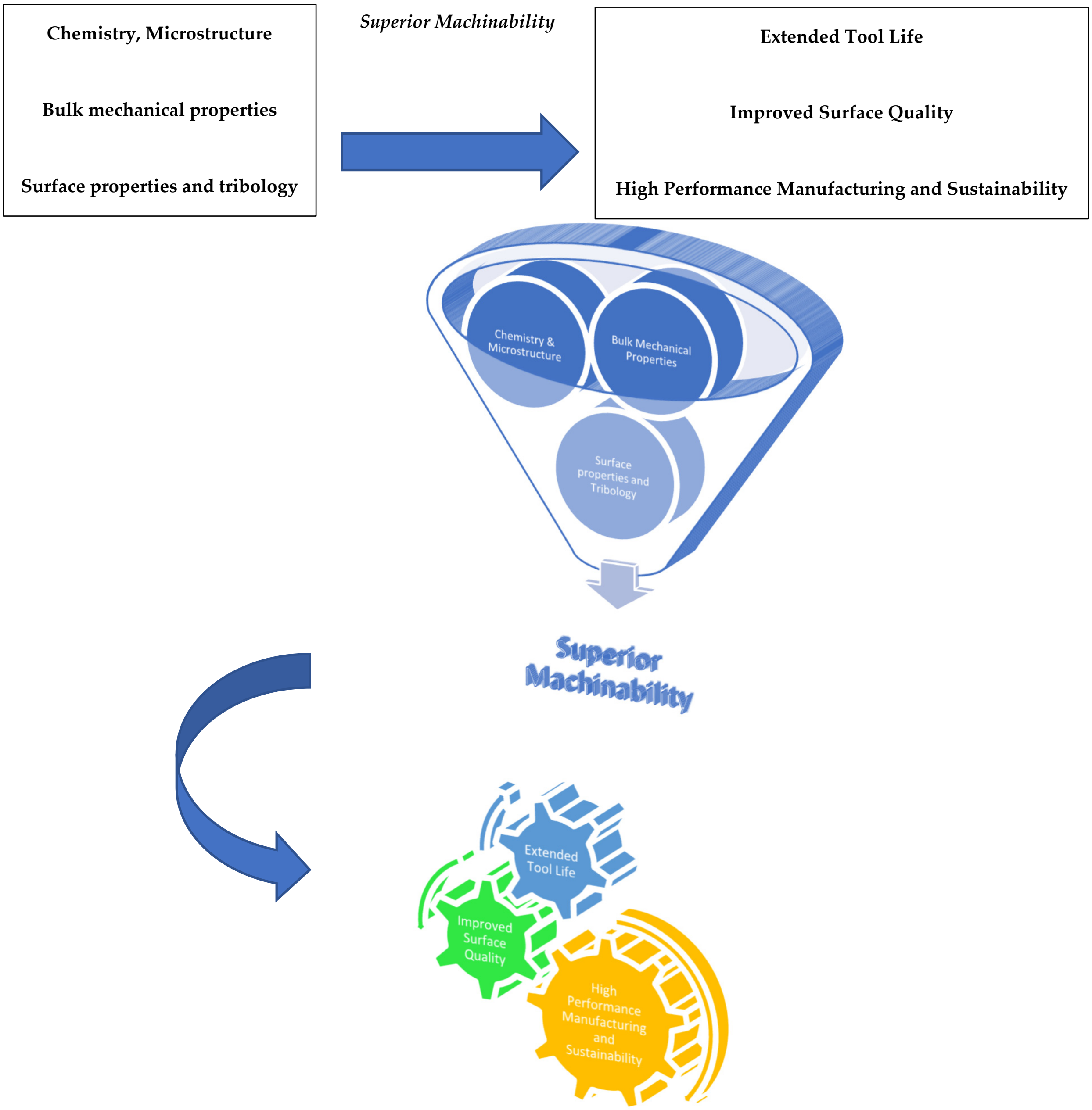

Figure 1. Schematic diagram illustrating that the special design of basic and generic material parameters could control level of the machinability and the major outcomes.

2. Contributions

The Special Issue "Machinability and Tribological Performance of Advanced Alloys" contains fifteen research articles [1–15], including one review paper [5]. The contents of this collection cover a wide spectrum of cross-disciplinary fields related to the machinability and tribological behaviour of materials with a variety of industrial applications. In addition, there are a few papers that, although they are not directly relevant to the core-subject area, provide valuable insight into the broader area of manufacturing technology [2,8] and the advanced characterization methodology of W-Cu nanocrystalline materials using FEM nanoindentation [4].

The main papers take a materials-focus perspective utilizing various manufacturing processes, such as turning [5,13], planing [10] and electric discharge machining [3,15]. A review paper reported on the basic categories of leaded and lead-free machinable brass alloys [5], while a specialized crystallographic investigation using Electron Backscatter

Diffraction (EBSD) analysis revealed the texture and fracture behaviour relationships of lead-free machinable brass alloys (such as CW511L and CW510L) [7]. Texture and phase analyses were performed before and after a heat treatment, which was applied for machinability improvement [7]. The combination of LAGBs and Σ3 boundaries together with β-phase content play a significant role in energy absorption and fracture resistance development [7]. The influence of induction heating on the machining of an SDK11 (high C, Cr-Mo) alloy steel is presented [12]. According to this study, the steel microstructure was not changed after heating it at a temperature between 200 and 400 °C, while a significant cutting force reduction was observed [12]. In [13], a comparative study on vibration monitoring among three brass alloys, two lead-free ones (CW510L and CW724R) and one leaded one (CW614N) was performed. According to this research, on average, CW510L and CW614N brass alloys demonstrated three times lower vibration damping values compared to that of CW724R brass alloy. In [15], the surface quality of an EDM-treated nickel based superalloy (Inconel 617) using cryogenically and non-cryogenically treated electrodes and various modified dielectrics of transformer oil was investigated.

Tribological behaviour research that aimed to improve the lifetime of materials/components by increasing the wear and/or corrosion resistance was undertaken in [1,6,9]. A comparative study concerning the abrasive wear resistance of different plughshare steels is presented in [9]. Furthermore, a study on the lubrication efficiency of Inconel 718 and the WC tribosystem is presented in [11]. The sulfurized fatty acid ester results in excellent anti-wear and anti-friction properties [11]. According to [14], a reverse thermal model and parametric modelling were applied to predict the temperature history of surface clads (carbide/steel systems) produced via a Concentrated Solar Energy surface treatment (CSE). This could result in the correlation between CSE processing parameters and the performance of created surface layers.

The content of the Special Issue is also presented to facilitate the readership and for taxonomy purposes (Table 1).

Table 1. List of topics and materials elaborated in the contents of the current S.I.

Reference Number	Relevant Topic			Materials
	Machinability	Tribology/Surface Properties	Miscellaneous	
[1]		X		X210CrW12 steel
[2]			X	AA5083 Al-alloy
[3]	X			DC53 steel
[4]			X	W-Cu (nanocrystalline)
[5]	X			Copper alloys (brasses)
[6]		X		Fe-Bulk metallic glasses
[7]	X			Copper alloys (brasses)
[8]			X	Mild steel
[9]		X		Steels (mainly S355J2G3, 37MnSi5, Hardox 450, UTP 690, OK 84.58)
[10]	X			EN C45 carbon steel
[11]		X		Inconel 718/WC
[12]	X			SKD11 Alloy Steel
[13]	X			Brass alloys (CW510L, CW614N, CW724R)
[14]		X		TiC/carbon steel, Cr_3C_2/carbon steel
[15]	X			Inconel 617

3. Conclusions and Outlook

The current Special Issue aims to place emphasis on this critical area of manufacturing, shedding light onto relationships governing the mutually influenced and interrelated properties of the machinability and tribological behaviour of metallic materials.

Since the industry demands more sustainable, energy efficient- and environmental-/ health and safety (E&HS)-friendly solutions, more research will be conducted on innovative and "green" materials (such as eco-friendly or lead-free copper alloys, environmentally friendly coatings and lubricants) and cost-efficient manufacturing processes. Industrial digitalization and modernization (in the frame of Industry 4.0) may further contribute to high-performance lean production, leading to the highest quality products and components, displaying minimum variation in their quality characteristics.

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Profound Appreciation and Dedication : The launch of the current Special Issue occurred almost three years ago and coincided with the outbreak of COVID-19, which was an unprecedented, dystopic period during which millions of lives were lost, people were fearful, strict measures were applied, including social distancing and the abrupt interruption of communication. At that time, Stoic philosophical/thinking principles provided me with outstanding mental support, courage, discipline and the vision to try to do the best I could within my power and my control. During this sorrowful and "dark" period, I received plentifully special and dedicated support from "close and skillful contributors and friends" who gave me courage and strength to continue and keep persisting towards my targets and goals. Because I feel sincerely indebted to them, I would like to express my deepest gratitude to these talented and Amazing Supporters (abbreviated as A.S.) who showed the path to find joy and the flowers of life. A.S. contributed to building an "inner citadel", which together with the catalytic influence and wise insight amply offered to me, will remain unforgettable.

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