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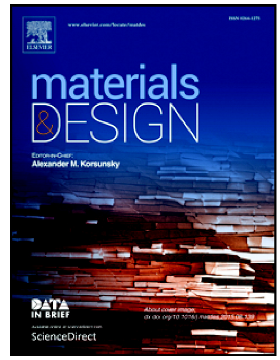

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MATERIAL SELECTION FOR MICRO-ELECTRO-MECHANICAL-SYSTEMS (MEMS) USING ASHBY'S APPROACH

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Abstract

A key aspect in design optimization of a product or a system is the selection of materials that best meet the design needs, ensuring maximum performance and minimum cost. Ashby's approach, originally introduced for macro-systems and products, has been very successfully employed for Micro-Electro-Mechanical-Systems (MEMS) / micromachined sensors, actuators and devices. This paper presents a comprehensive review and critical analysis of MEMS material selection studies using Ashby's approach reported in the literature during the last two decades. Performance and Material Indices derived for various microsystems and MEMS devices have been summarized. Moreover, all MEMS materials reported in the literature and the most suitable materials proposed for a variety of MEMS systems and devices have also been consolidated. A material selection case study utilizing micro-scale properties of 51 MEMS compatible materials has been presented to demonstrate that the use of different materials' bulk properties is not the best choice for MEMS materials selection. This paper will serve as a reference guide and useful resource for researchers and engineers engaged in the design and fabrication of various microsystems and MEMS sensors, actuators and devices.

Key Words:

Material Selection, Ashby's Methodology, Microsystems, Micro-Electro-Mechanical-Systems (MEMS), Performance Index, Material Index, Design Optimization, Product Design

List of Symbols

Symbols	**[Units]**		**Nomenclature**
σ_f	*[Pa]*	:	*Fracture strength*
E	*[Pa]*	:	*Young's modulus*
a	*[m]*	:	*Diaphragm length*
C_1, C_2	*[1]*	:	*Constants*
p	*[Pa]*	:	*Pressure change*
L	*[m]*	:	*Length*
ρ	*[Kg/m^3]*	:	*Density*
K	*[N/m]*	:	*Stiffness*
m^*	*[Kg]*	:	*Effective mass*
b	*[m]*	:	*Width*
h	*[m]*	:	*Thickness*
B	*[J / ^{o}K]*	:	*Boltzmann constant*
T	^{o}K	:	*Absolute temperature*
β	*[Hz]*	:	*Band width*
χ	*[1]*	:	*Loss coefficient*
p	*[Pa]*	:	*Static Pressure*
δ	*[m]*	:	*Deflection*