An experimental study on the performance of square and circular air pads for ultra precision machines in nano machining

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The machine tool which is used in nano machining technology called ultra precision machine, is a relatively new device among traditional ones. In this machine there are two main assemblies creating rotational and linear motions, called air spindle and linear air table respectively.

The linear air table can be simulated experimentally by a linear air bearing, because it works according to the gas bearing principles. Pressurized air is injected to the gap between mating parts through an air pad. Compressed air or other gases are used for the lubrication of sliding surfaces. Different parameters of the air pad play decisive roles on its characteristics, and have influence on the performance of the air slide table consequently. The table has linear motion in main direction, X, and has straight error motion in Y and Z directions as well. The error amount is not constant and varies due to different parameters.

This investigation deals with the influential parameters and their contribution to the error. In this study, two single air pads were manufactured as representatives of an air table, and the effects of different parameters were investigated on their performance.

The shape of air pad along with other parameters like, air pressure, location, and the amount of external load have been studied experimentally. Results show that there will be less error motions for the case of circular air pad. The error amount is not similar in X and Y direction. Finally the best air pressure and external load, and load location have been derived.

[**1**] Sinan Badrawy Workshop on Micro Manufacturing, NSF, Machine Tools for Ultra-Precision and Micro Manufacturing Moore Nanotechnology Systems, LLC, August 12, 2004.

[2] http://www.abtechmfg.com/pdf/mag_linear_slide_mlab.pdf

[3] Xichun Luoa, Kai Chenga, Dave Webba, Frank Wardle, Design of Ultra Precision Machine tools with applications to manufacture of miniature and micro components, Journal of Materials Processing Technology, 515-528 , 2005

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Modelling studies on Water management in PEM Fuel Cells

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The potential of fuel cells for clean and efficient energy conversion is generally recognized. Proton-exchange membrane (PEM) Fuel Cells are among the different types of fuel cells one of the most promising. The water management is a critical problem to overcome in the PEM fuel cell technology. Despite several studies on this

topic effective water management is still elusive. Models play an important role in fuel cell development since they enable the understanding of the influence of different parameters on the cell performance allowing a systematic simulation, design and optimization of fuel cells systems.
In this work, a recently developed 1D model [1] coupling heat and mass transfer is used to predict the influence of several parameters on the water transport across the membrane of a PEMFC. The water transfer is assumed to be a combined effect of diffusion and electro-osmotic drag. Effective Fick models for the mass transport in the gas diffusion layers, catalytic layers and membrane are considered. The model was validated with recent published data. The influence of the membrane thickness and transport properties, of the GDL thickness and structure, of the thickness of the catalytic layers, of the reactants pressure and humidification temperatures on the water content through the membrane and on the cell performance was studied. This work represents a useful tool to set-up suitable operating conditions and optimized tailored MEAs to produce a better performance of PEM fuel cells.

[1] Falcão, D.S., Oliveira, V. B., Rangel, C. M., Pinho, C. and Pinto, A.M.F.R., "One dimensional modelling with heat transfer effects for PEM Fuel Cells", Chemical Engineering Science, submittet

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Measurement and simulation of pollutant emissions from marine diesel combustion engine and their reduction by ammonia injection

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Taking into account the complexity and cost involved to conduct an experimental investment , the recourse to a tool of simulation, which in turn entails access to information by measurement, offers an effective and fast alternative to deal with the problem of pollutant emissions from internal combustion engines. An analytical model based on detailed chemical kinetics employed to calculate the pollutant emissions of a marine diesel engine gave results, in general, satisfactory compared to experimentally measured results. Especially the NO emission contents are found higher than the standards limiting values set out by the International Maritime Organization (IMO). Thus, this study is undertaken in order to reduce as much as possible these emissions.

The reduction of pollutant emissions is apprehended with ammonia injection.

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