UG PROJECTS UNDERGONE AND PAPERS PUBLISHED ON MEMS IN THE YEAR OF 2018-19

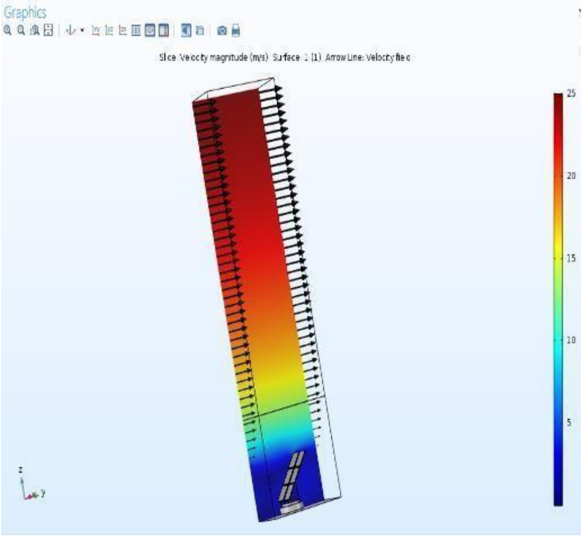
1. Design and simulation of Solar Panel in Periodic Flow Control

Submitted by Harshitha M S 4AL15EC039
Manjula P 4AL15EC047
Guided by: Mrs. Sahana K Adyanthaya

ABSTRACT

Solar panel has been a well-known method of generating clean, emission free electricity. It produces only Direct Current electricity (DC), which is not what normal appliances use. Solar Photovoltaic (PV) systems are often made of solar PV panels (modules) and inverter (changing DC to AC). Solar PV panels are mainly made of solar photovoltaic cells, which have no fundamental difference to the material for making computer chips. The process of producing solar PV cells (computer chips) is energy intensive and involves highly poisonous and environmental toxic chemicals. There are few solar PV manufacturing plants around the world producing PV modules with energy produced from PV. This measure greatly reduces the carbon footprint during the manufacturing process. Managing the chemicals used in the manufacturing process is subject to the factory's local laws and regulations.

The solar panel placed in the periodic flow control model will produce the wind with the maximum velocity, pressure density which can be used for different applications for example the obtained heat & electricity can be used in running the steam engines. The heat is generated inside the model from the dissipated energy from the solar panel. When the wind is allowed to pass through the solar panel its velocity, pressure and density will be changed. The other chemical liquids , gases can also be used in the simulation instead of the wind in the model but it takes long time for simulating so wind has been used for the simulation.



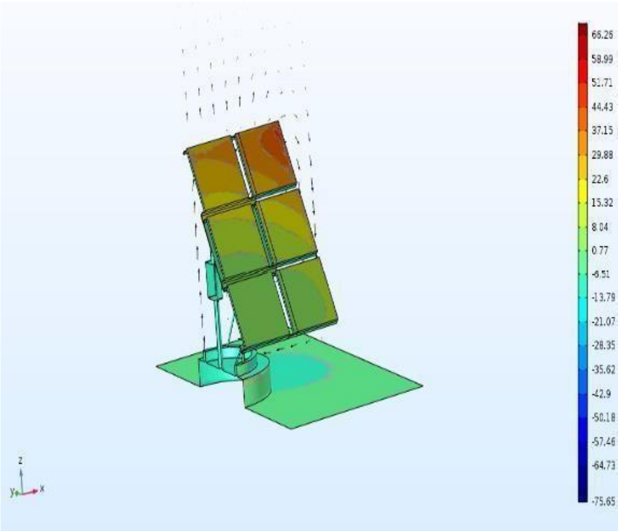


Fig: Velocity magnitude and arrow Line

Fig 2 : Pressure of the wind

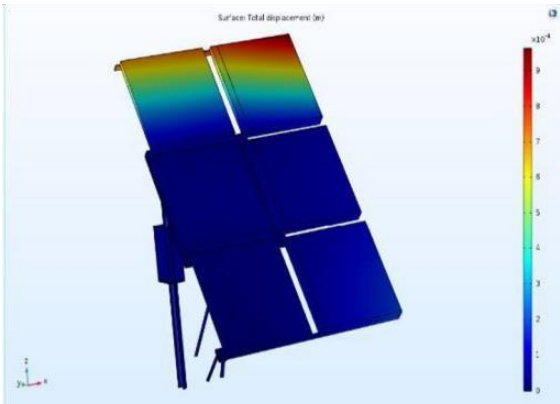


Fig 3:Total displacement (m)

International Journals of Applied Engineering Sciences & Intendence www.ijaesi.com
Vol. 5, Issue 6, April 2019

Review paper on Solar Panel in Periodic Flow Control

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Abstract:

Solar panel has been a well-known method of generating clean, emission free electricity. However, it produces only direct current electricity (DC), which is not what normal appliances use. Solar photovoltaic systems (solar PV systems) are often made of solar PV panels (modules) and inverter (changing DC to AC). The solar panel placed in the periodic flow control model will produce the wind with the maximum velocity, pressure density which we can use for different applications.

1. MEMS introduction

MEMS is a process of technology used to create timing integrated devices or systems that combine mechanical and Electrical components. They are fabricated using integrated circuits (IC) batch processing techniques and can be range in size from a few micrometres to millimetres. MEMS technology exploits. The existing microelectronics infrastructure to create complex Machines on a micrometre scale.

Extensive applications for these devices exist in both commercial and industrial systems. The multiphysics nature of MEMS devices requires that a system designer has a vast understanding and knowledge of these various branches of physics. Because some micro scale effects are totally new or behave differently than at the macro scale, engineers require new system design philosophies. Thus the MEMS engineer is a true systems designer, handling several physical phenomena simultaneously and COMSOL.

Multiphysics and the MEMS Module can do the same. Most MEMS devices are manufactured using lithography based micro fabrication, a technology that the microelectronics industry has refined for highly integrated circuits. Thanks to these efforts there are excellent methodologies and facilities for mass production. Suppliers can thus set the price of microsystems at a totally different level compared to their macro scale counter parts.

2. MOTIVATION

To support this background it is essential that we acquire indigenous capability be acquired to design, develop and install solar thermal plants. For this, establishing a demonstration cum

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IJAESI Journal, Volume 5, Issue 6, April 2019

2. Performance Improvement Of Direct Methanol Fuel Cell Using Modified Nafion Membrane

Submitted by	ANANYA M	4AL15EC008
	ARPANA	4AL15EC011
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ABSTRACT

The Direct Methanol Fuel Cells (DMFC) is a subcategory of Proton Exchange Membrane Fuel Cells (PEMFCs) in which methanol is used as a fuel. PEMs are important components of fuel cells which conduct protons. In this paper the proposed work provides to use methanol as fuel to realize DMFC. The Membrane Electrode Assembly (MEA) of DMFC is sandwiched between two silicon chips with micro channels consists of a micro-porous Gas Diffusion Layer (GDL) layer which regulates the flow of methanol to the catalyst at the anode, a high efficiency catalyst layer for the generation of protons (H+) and electrons (e-) from methanol, a high proton conductance membrane layer for the transfer of protons and a high efficiency catalyst at the cathode for the conversion of oxygen and H+ into water. In modern cells, electrolytes based on proton conducting polymers i.e., electrolyte membranes (e.g., Nafion) are often used, since these cells can be operated under high temperature and pressure.

A 3D DMFC model has been used to analyze the effect of nafion membrane thickness and GDL thickness on the performance in a single fuel cell. At 25°C, the fuel cell has the optimal relative humidity in the PEM, which allows proton to travel from anode to cathode of DMFC. Nafion 117 was coated with various thicknesses of Poly Vinylidene Fluoride (PVDF) polymer and its effect on fuel cell performance was studied. The power density of DMFC PVDF coated Nafion 117 higher than that of native Nafion 117 because, the coating, introduces hydrophobic surface on Nafion 117 and hence, methanol is repelled from nafion surface thereby causing reduction in methanol crossover, which gives better performance when compared to uncoated Nafion 117.The DMFC has lot of advantages, such as low energy consumption, high energy density, simple system, which is easy to carry, storage and supply. The improvement of comprehensive characteristics of proton exchange membrane represents one of the most critical challenges for the large scale commercialization of PEM fuel cells.

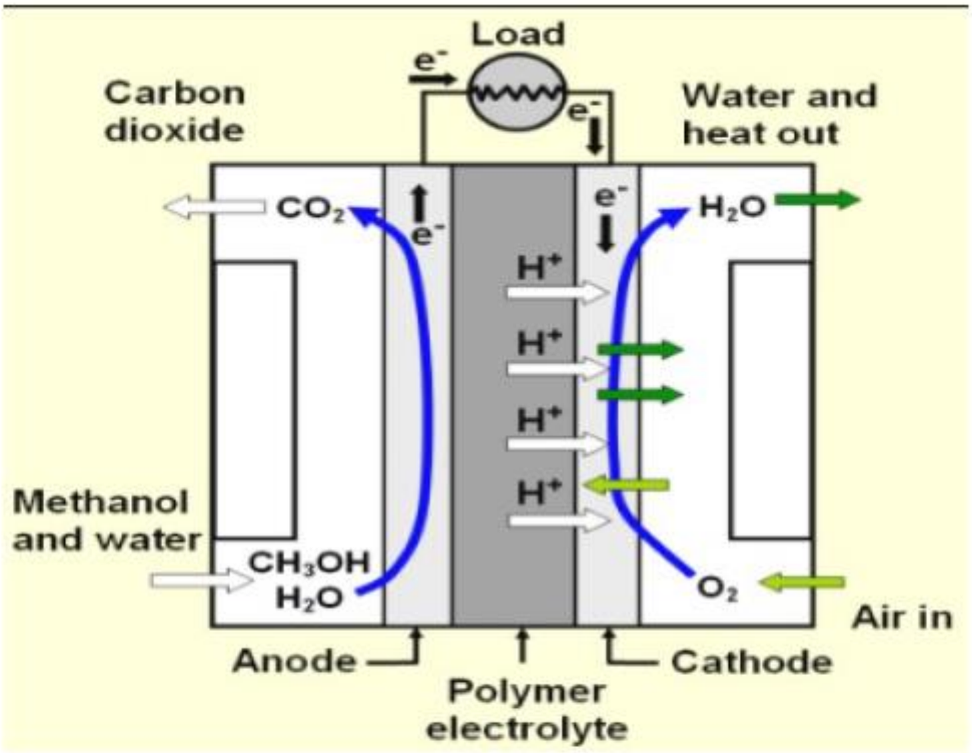

Figure1: Schematic of DMFC

International Journal of Research and Scientific Innovation (IJRSI) | Volume VI, Issue IV, April 2019 | ISSN 2321–2705

A Progress Review on Performance Improvement of Direct Methanol Fuel Cells Using Modified Nafion Membrane

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Abstract—**Proton exchange membranes (PEMs) are important components of fuel cells in which either hydrogen or methanol are used as fuels. In this paper we propose to use methanol as fuel to realize micro direct methanol fuel cells (µDMFC). The membrane electrode assembly (MEA) of µ-DMFC consists of a micro-porous layer which regulates the flow of methanol to the catalyst at the anode, a high efficiency catalyst layer for the generation of protons (H+) from methanol, a high conductance membrane layer for the transfer of protons and a high efficiency catalyst at the cathode for the conversion of oxygen and H+ into water. Simulation results indicate that the cell voltage decreases with increase in membrane thickness from 50 µm to 200 µm.**

Keywords: **PEM, µDMFC, MEA, Nafion 117**

I. INTRODUCTION

The Fuel cells are leading contenders for clean energy generation for variety of applications especially for wearable and portable devices. It is an energy conversion device which converts chemical energy of fuel in to electrical energy. The Direct-Methanol Fuel Cell (DMFC) is a subcategory of proton-exchange fuel cells in which methanol is used as a fuel. The DMFC devices are growing rapidly, recognized internationally and these devices are increasingly finding applications in many types of electronic devices. In recent years there is much demand on portable electronic devices such as cell phones and laptop computers. Therefore various energy storage and conversion systems have emerged in order to provide electrical power for portable devices with mechanical stability and high efficiency as well as environmental benefit and cost-effectiveness. DMFC has lot of advantages, such as low energy consumption, high energy density, simple system, abundant and low-cost fuel, which is easy to carry, storage and supply, and also a long time for power supply. Therefore, DMFC will be the most promising substitute for secondary batteries which are being used widely.

However, in India, there is no major effort in the development of technology for DMFC. The DMFC consists of a proton conducting membrane (Nafion 117) which is sandwiched between two gas diffusion layers (GDL); this Membrane Electrode Assembly (MEA) is the heart of DMFC. The Methanol diffuses through the micro-porous layer which regulates the transport of methanol to the catalyst which generates protons. The protons then diffuse through the membrane to the cathode. The protons react with oxygen at the cathode to form water. The equations for the process are as below: Anode reaction:

$CH_3OH + H_2O \rightarrow 6\,H^+ + 6e^- + CO_2$ (Oxidation) ------(1.1)

Cathode reaction:

$3/2\ O_2 + 6\,H^+ + 6e^- \rightarrow 3H_2O$ (Reduction) -------(1.2)

Overall reaction:

$CH_3OH + O_2 \rightarrow 2H_2O + CO_2$(Overall Redox reaction) - (1.3)

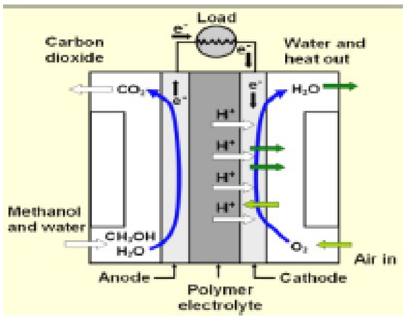

Figure1: Schematic of DMFC

The entire MEA is sandwiched between two silicon chips with micro channels which contain the flow of methanol at the anode and flow of air at cathode. The negative charge is collected by the metallic electrode, which moves into the external circuit from anode to cathode, thus balancing the charge transfer process. On the outside of the MEA, backing layers made of non-woven carbon paper or woven carbon cloth, are placed to fulfil several functions. The primary purpose of a backing layer is to provide lateral current collection from the catalyst layer to the ribs as well as optimized gas distribution to the catalyst layer through diffusion. It must also facilitate the transport of water out of the catalyst layer. This latter function is usually accomplished by adding a coating of hydrophobic polymer, polytetrafluoroethylene (PTFE), to the backing layer.

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3. Whispering Gallery Mode Resonator at Terahertz Frequency domain: A Brief Review

Submitted by **PAVAN K RAO**
SAKKUBAI S
SANDHYA B. J
BHAGYA B.V

Guided by **PROF. ANEESH JAIN M.V**

ABSTRACT

We describe a novel band stop filter based on using Whispering Gallery (WG) modes in high-density dielectric resonators (DR). Based on this approach, we demonstrate a filter with center frequency. High order whispering gallery (WG) mode dielectric resonators (DR's) are attractive for filter applications, since they can generally have a small size, and high Q's at high frequency. The whispering-gallery mode of resonance of high-permittivity dielectric resonators appears to be mostly useful in the millimeter-wave region, where more conventional dielectric resonators are impractically small. Because of the high modal purity, this type of resonator should be useful as a filter element in the millimeter-wave range of frequencies. Coupling schemes conventionally used with WG mode DR's include loop, waveguide. The band stop filter, also known as a band reject filter, passes all frequencies with the exception of those within a specified stop band which are greatly attenuated. When the length of the ring waveguide is a integer number of wavelengths, the ring waveguide is resonant to the wavelength and the light power stored in the ring builds up. The wave transmitted through the straight waveguide is the interference of the incident wave and the wave that couples over from the ring to the straight waveguide. This makes the optical ring resonator an ideal notch filter, blocking the light at the resonant wavelength. The proposed notch filter shows almost zero transmittance at resonance.

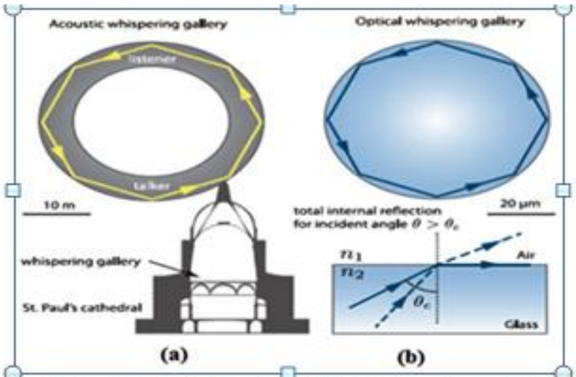

Figure 1: WGMs supported by total internal reflection in (a) an acoustic mode, and (b) an optical wave.

Fig .2: Image of microdisc

ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Website: www.ijareeie.com

Vol. 8, Issue 4, April 2019

Whispering Gallery Mode Resonator at Terahertz Frequency domain: A Brief Review

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ABSTRACT: Whispering Gallery Mode Resonators represent a class of cavity devices with exceptional properties such as extremely small mode volume, very high power density, and very narrow spectral line width. Their importance for applications in very sensitive micro-sensors, have been recognized only in recent years. The sensitivity of this resonant technique has been found to be single molecular level, higher than that compared to most optical single pass devices such as Surface Plasmon Polariton. In this paper we present a brief review of the field of WGM resonators, which includes the basic concept, the geometrical structures of resonators, different materials and methods.

KEYWORDS: WGMR, dielectric, THz, Optical resonators

I. INTRODUCTION

Whispering gallery modes or waves are specific resonances modes of a wave field (e.g. sound waves, electromagnetic waves) inside a given resonator (a cavity) with smooth edges. They correspond to waves circling around the cavity, supported by continuous total internal reflection off the cavity surface, that meet the resonance condition.After one roundtrip they return to the same point with the same phase (modulo) andhence interfere constructively with themselves, forming standing waves). These resonances depend greatly on the geometry of the resonator cavity.The report on recent study of resonators made out of sapphire, diamond, and quartz crystals and discuss possible applications of these resonators. Here we discuss resultsconcerning fabrication of high-Q sapphire, diamond, and crystal quartz whispering gallery mode resonators, and demonstrated the highest reported Q-factor in a monolithic resonators fabricated out of the materials[1].The resonators can be useful in a variety of scientific and technical applications, includingfabrication of ultra-stable optical etalons, cavity stabilized lasers, and opto-electronic radio frequency oscillators. The electromagnetic and radiation fields are obtained by solving the time domain Maxwell's equations using the finite element analysis [5]. It is found that the increase of either effective microsphere size or the refractive index of the medium surrounding the microsphere down-shifts the WGM resonance frequency. The larger the change, the stronger is the shift. A linearrelationship between the variation of microsphere effective size and the resonance frequency shift is found.

This characteristic may be used for the monitoring of peptide growth in the solid phase synthesis. The glass based sphericalmicro resonators area easy to study and apply important physical effects [6]. Here they discuss about high sensitivity detection of disease marker in point of care testing, high throughput screening of lead compounds in drug discovery as well as basic research studies in various disciplines within the life sciences such as signal transduction, protein folding and membranebiophysics[7]. Demonstrated the feasibility to fabricate quartz and polyethylene whisperinggallery mode resonators for the THz frequency range with coinciding mode spectra overmore than ten times the free spectral range[8].Point out the advantage of large size and the possibility of post processing ofWGMresonators

4. Analysis of Antenna Impedance and Radiation Pattern for A Mono-Conical Antenna using MEMS

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	SUMANTH N S	**4AL15EC088**
Guided by	**Mr. ANEESH JAIN M V**	

ABSTRACT

An antenna is used to radiate electromagnetic energy efficiently and in desired directions. Antennas act as matching systems between sources of electromagnetic energy and space and the goal in design of antennas is to optimize this matching. All antennas may be used to receive or radiate energy. The required wideband omnidirectional mono-conical antenna used for reverberation chamber has been proposed. The antenna performance is analyzed using the COMSOL (v5.2) Multiphysics Simulation Tool. The simulation results show that the antenna has a good impedance and omnidirectional radiation characteristics, and It meets the performance requirements of the antenna used for reverberation chamber. The proposed antenna shows the measured value of VSWR within 0.2-1.5 GHz is less than 20dB which is in accord with the theoretical value.

Conical antennas are useful for many applications due to their broadband characteristics and relative simplicity. This example includes an analysis of the antenna impedance and the radiation pattern as functions of the frequency for a mono conical antenna with a finite ground plane and a 50 Ω coaxial feed. The rotational symmetry makes it possible to model this in axially symmetric 2D. When modelling in 2D, you can use a dense mesh, giving an excellent accuracy for a wide range of frequencies. In the demonstrated work on conical antenna we are majorly considering 3 factors of antenna parameters they are: improvement in the impedance factor of the antenna, generating suitable radiation factor for the desired frequency, indicating the usage of conical antenna in various applications, verifying the high gain and high frequency operation for

conical antenna. The designed antenna can be used as a transmitting antenna, at the same time; it also can be used as a receiving antenna because of its small size and the omnidirectional radiation.

The size of the antenna is reduced enormously. It is convenient to take along and install, and it has well practical values.

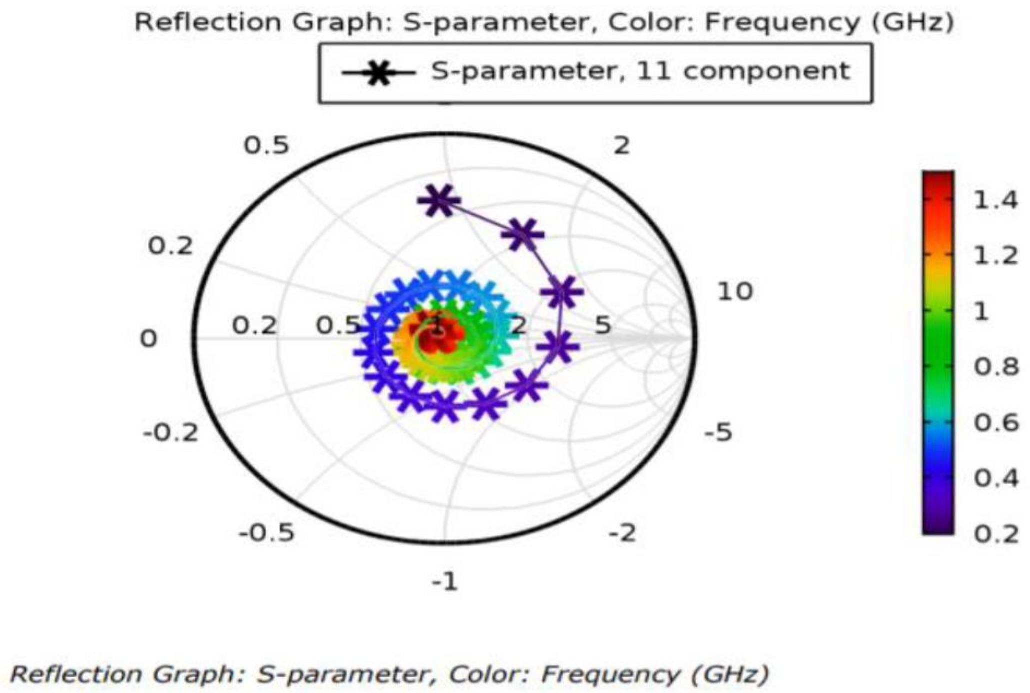

Fig 6.1: Smith plot graph for 50ohms

Table 6.6 Comparison of results

Impedance	Frequency	Directivity
30 ohms	1.5GHz	19.52
50 ohms	1.5GHz	19.08
100 ohms	1.5GHz	13.51

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Authored by

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Has been published in

IJAESI Journal, Volume 5, Issue 4, April-2019

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