PROGRAM (final)

The 4th Japan-China-Korea Joint Conference on MEMS/NEMS (JCK MEMS/NEMS 2013)

August 22 - 24, 2013, CENTER HALL, Tohoku University

Thursday, August 22, 2013

11:30- **Welcome Registration,** Welcome drink

13:00-13:10 **Opening Address;** Prof. Eiji Higurashi, The University of Tokyo

13:10-14:30 **Memorial Tutorial;** Prof. Masayoshi Esashi, Tohoku University

14:30-15:00 **Invited Talk 1 "Nanostructured Micromeshes"**
Prof. Jong Soo Ko, Pusan National University

15:00-15:30 **Break**

15:30- **Tour**

Friday, August 23, 2013

8:45-14:30 **Oral Presentation**

	Chair: Prof. Dong-Won Lee, Prof. Xueyong Wei		
8:45-9:00 O-01	Introduction of the Application of Wireless Laser Doppler Blood Flow Meter for the Measurement of Chicken Blood Flow	Kei Nishihara, Wataru Iwasaki, Masaki Nakamura, Toshihiro Itoh, Ryutaro Maeda, Renshi Sawada	Kyushu University
9:00-9:15 O-02	Three-dimensional integrated scaffold containing aligned nanofiber matrix for muscle tissue engineering	PARK Suk-Hee, YANG Dong-Yo, LEE Hye-Jin, LEE Nak-Kyu	KITECH
9:15-9:30 O-03	MEMS-IC integration for wireless sensor network applications	J.Lu, Y.Nakano, L.Zhang, H.Kuwabara, H.Takagi, R.Maeda	AIST
9:30-9:45 O-04	Collaboration magic between simulation-based engineers and experiment-based researchers in BEANS project	Akira Tezuka, Hitoshi Nitta, Yasuro Irie	AIST
9:45-10:30	Café & Poster session		

	Chair: Dr. Nak-Kyu Lee, Prof. Kentaro Totsu		
10:30:10:45 O-05	Application of micro blood flowmeter to observe the physiological effects of alcohol injestion	Wataru Iwasaki, Nogami Hirofumi, Renshi Sawada	AIST
10:45-11:00 O-06	Supercritical Fluid Deposition and Characterization of Carbon Nanotubes-Cu Composite	Zhonglie An, Masaya Toda, Takahito Ono	Tohoku university
11:00-11:15 O-07	Transfer of thin film copper micro-electrodes to flexible PDMS	Ikjoo Byun, Anthony W. Coleman, Masaaki Ichiki, Beomjoon Kim	The University of Tokyo
11:15-11:30 O-08	Nanoprecision Alignment and Low-Temperature Bonding for Multifunctional Nanofluidic Chips	Chenxi Wang, Kihoon Jang, Yan Xu, Kazuma Mawatari, Takehiko Kitamori	The University of Tokyo
11:30-11:45 O-09	Fabrication of Superhydrophobic Microstructured Surfaces using Cu-Ni electrodeposition	J.M. Lee, K.K. Jung, J.S. Ko	Pusan National University
11:45-12:00 O-10	Suppression of Curvature in MEMS Membrane	Tomomi Sakata, Keita Yamaguchi, Naru Nemoto, Mitsuo Usui, Kazuyoshi Ono, Kazuhiko Takagahara, Kei Kuwabara, Yoshito Jin, and Hiroshi Koizumi	NTT Corporation
12:00-13:00	Poster session		

	Chair: Prof. Haixia Zhang, Dr. Hye-Jin Lee		
13:00-13:15 O-11	Numerical and Experiment to Predict Die Shift in Compression Molding for Wafer Level Packaging	Si-Mo Yeon, Jeanho Park, Nak-Kyu Lee, Seogou Choi, Hye-Jin Lee	KITECH
13:15-13:30 O-12	Electroless Copper Plating on Polyimide Substrate with Submicron Pattern Modified by UV Irradiation	Sang-Cheon Park, Kenta Suzuki, Junho Choi, Takahisa Kato, Sung-Won Youn, Hideki Takagi, Hiroshi Hiroshima, Ryutaro	AIST
13:30-13:45 O-13	Bulk Acoustic Mode Resonators: Design, Characterization and Application	Xueyong Wei and Ashwin Seshia	Xi'An Jiaotong University
13:45-14:00 O-14	Monolithic Integration of Film Bulk Acoustic Wave Resonator on CMOS Circuit	Abhay Kochhar, Masayoshi Esashi, Shuji Tanaka	Tohoku university
14:00-14:15 O-15	Flexible Thermoelectric Power Generator Combined with Cu Thermal Guides Array	Sihuang Zhao, Yusuke Kawai and Takahito Ono	Tohoku University
14:15-14:30 O-16	Tuner integrated resonant micro mirror scanner for compensation of non-liner spring effect	Yusuke Kawai and Takahito Ono	Tohoku university

14:30- to Akyu, Hotel IWANUMAYA

18:30- **Banquet**

Saturday, August 24, 2013

9:30-10:00 **Invited Talk 2 "A novel method to improve the performance of a mechanical nano-sensor"**
Prof. Zhanoying Zhou, Tsinghua University

10:00-12:15 **Oral Presentation**

	Chair: Prof. Shuji Tanaka		
10:00-10:15 O-17	Development of High-Accuracy and Non-Contact Current Sensor	Shinya Mito, Kazuma Takenaka, Satoshi Kato	NMEMS Technology Research Organization
10:15-10:30 O-18	CO2 Gas Sensor using Ionic-Liquid Gel	Masahito Honda, Toshihiro Itoh, Ryutaro Maeda	NMEMS Technology Research Organization
10:30-10:45	Café		
10:45-11:00 O-19	An AlN cantilever for air differential pressure detection with high sensitivity	Y. Kaiho, H. Takahashi, Y. Tomimatsu, T. Kobayashi, K. Matsumoto, I. Shimoyama, T. Itoh, R. Maeda	NMEMS Technology Research Organization

	Chair: Prof. Niancai Pen, Prof. Yoshiaki Kanamori		
11:00-11:15 O-20	Relation between Q-factor and resonance mode of polymer cantilevers	N. Shiraishi, M. Kimura, Y. Ando	NMEMS Technology Research Organization
11:15-11:30 O-21	A windmill-structured electromagnetic energy harvester	Xuan Wu, Mitesh Parmar, Dong-weon Lee	Chonnam National University
11:30-11:45 O-22	Surface-micromachined Planar Piezoresistive Vibration Sensor	Lan Zhang, Jian Lu, Hideki Takagi, Ryutaro Maeda	AIST
11:45-12:00 O-23	Development of Piezoelectric MEMS Devices	T. Kobayashi, N. Makimoto, Y. Suzuki, H. Okada, H. Nogami, Hiroshi Funakubo, S. Oyama, T. Uriu, N. Moriwaki, Y. Tomimatsu, T. Itoh, R. Maeda	AIST
12:00-12:15 O-24	Development of MEMS Viscosity Sensor with Dual Spiral Vibrating Beams	Y. Yamamoto, S. Matsumoto, T. Yamamoto, S. Choi , M. Kuroda, H. Yabuno	AIST

13:00-15:30 **Tour**

Poster Presentation

Friday, August 23, 2013

P-01	Pico-calorimeter using a resonant thermal sensor	Naoki Inomata, Takahito Ono	Tohoku university
P-02	Si Nanowire Probe with a magnet for Magnetic Resonance Detection	Yongjun Seo, Masaya Toda, Yusuke Kawai, Takahito Ono	Tohoku university
P-03	Study on micro droplet formation with cross-shape micro channels	Lang Nan, Shuangjiang Li, Zhuangde Jiang, Niancai Peng, Xueyong Wei	Xi'an Jiaotong University
P-04	The Novel structural Design for micro-pressure sensors	Bian Tian, Zhuangde Jiang, Jianjun Ding, Guoying Yuan	Xi'an Jiaotong University
P-05	Thermal Imaging using Temperature Sensitive Paint for High Speed Thermal Phenomena at Microscale	T. Tsukamoto, M. Esashi, S. Tanaka	Tohoku university
P-06	TiCuNi metallic glass thin films for biomedical applications	Neelam Kaushik, Parmanand Sharma, Samad Ahadian, Ali Khademhosseini, Masaharu Takahashi, Akihiro Makino , Shuji Tanaka, Masayoshi Esashi	Tohoku university
P-07	Schottky diode type hydrogen sensor on GaN nanonetwork	Aihua Zhong, Kazuhiro Hane	Tohoku University
P-08	A 20nm Free-Spectral Range Optical Filter Based on NEM-Tunable Silicon Photonic Waveguide Micro-Ring Resonator	Hoang Manh Chu, Takashi Sasaki, Kazuhiro Hane	Tohoku university
P-09	Fabrication of High Dielectric Constant Capacitors Embedded in Flexible Polymer by Molecular Glue	Yuki Amano, Ikjoo Byun, Masaaki Ichiki, BeomJoon Kim	The University of Tokyo
P-10	Transfer of PZT thin film capacitor using controlled spalling technology	Kazutaka Sueshige, Fumiaki Honda, Tadatomo Suga, Masaaki Ichiki, Toshihiro Itoh	The University of Tokyo
P-11	Low-temperature solid-state solder bonding process using hydrogen radical for MEMS packaging application	Hiromu Kawai, Eiji Higurashi, Tadatomo Suga	The University of Tokyo
P-12	Low-temperature Au-Au bonding using atmospheric-pressure plasma activation for optical micro-sensors	Michitaka Yamamoto, Eiji Higurashi,Tadatomo Suga, Renshi Sawada	The University of Tokyo
P-13	Strong light coupling between heterogeneous nanophotonic circuits using a fast-guided-mode photonic crystal waveguide	Borriboon Thubthimthong, Yuta Hayakawa, Takashi Sasaki, Kazuhiro Hane	Tohoku university
P-14	Design and Fabrication of a Large Stroke Continuous Membrane Deformable Mirror	Tong Wu , Takashi Sasaki, Masayuki Akiyama, Kazuhiro Hane	Tohoku university
P-15	Electrical characteristics of directly-bonded p-Ge/n+-Si interfaces	Ryuichiro Hanada, Y.Sasaki, Eiji Higurashi, Tadatomo Suga	The University of Tokyo
P-16	Evaluation of Surface Wettability by means of the Measurement of the Adhesive Force between a Microstructured Hydrophobic Surface and a Water Droplet	Kyung Kuk Jung, Seung-hwan Lee, and Jong Soo Ko	Pusan National University
P-17	Low temperature GaAs/SiC wafer bonding for high-power semiconductor lasers	H. Narusawa, K. Nakasuji, E. Higurashi, T. Suga	The University of Tokyo
P-18	Mechanical Properties Evaluation of Cu-TSVSpecimen	Hong Wang, Ting Gu, Zhaoyu Wang, Huiying Wang, Ping Cheng, Zhuoqing Yang, Guifu Ding	Shanghai Jiao Tong University
P-19	MEMS-tunable optical switches based on multiple ring resonators	Xin Li, Zheng Shi, Shumin He, Xumin Gao, Miao Zhang, Yongjin Wang	Nanjing University of Posts and
P-20	In-plane Distribution of Piezoelectric and Ferroelectric Properties of Pb(Zr,Ti)O3 Thin Film Devices on 200 mm SOI Wafer	Nobuyoshi Moriwaki, Takeshi Kobayashi, Yasuhiro Suzuki, Natsumi Makimoto, Koji Fujimoto, Kosuke Suzuki, Toshihiro Itoh, Ryutaro Maeda	NMEMS Technology Research Organization
P-21	Fabrication of Microstructure Array using Anisotropic Wet Etching	Sunao Murakami, Seigi Shimizu, Takahiro Ito	Kyushu Institute of Technology
P-22	Electrode thickness control by ink-jet printing with selective surface treatment for dielectrophoresis chip	Gyu-young Yun, Seung-Hyun Lee, Huiseok Kang, Sang Ho Lee	KITECH
P-23	The Development of High Functional Alloy Plating Using Nano-Phase	Jeon Mo Choi, Joon Kyun Lee	KITECH
P-24	Reserach on 2-dimensional structrure using three beam interfence lithography	Jeong-Il Gyu, Jong-Seok Kim, Sung-Ho Lee	KITECH
P-25	Application of Nano-imprint to simultaneous forming of concentric miniature concavo-convex patterns and a large through-hole with high accuracy	Toshihiro Takeshita, Takuma Iwasaki, Eiji Higurashi, Tatsuya Miyazaki, Renshi Sawada	Kyushu University
P-26	Study on Electrochemical sensor for detection of biofilm	Byeong-Jun Hwang, Jong-Soo Ko, Sung-Ho Lee	KITECH
P-27	Micro/Nano Manufacturing and Its Applications via Inter-University Networking between Universities and AIST - Under One Roof Report – Part 2	Dong F. Wang, Ryutaro Maeda	Ibaraki University
P-28	A biochip for diagnosing ovarian and colorectal cancer using MMP-2 and MMP-7	In Jae Seo, Seung Yong Lee, Jun MO Han, Je Sik Jeong, Seung Yong Hwang, Yoo min Ahn	Hanyang University
P-29	Study on serial stack structure for improving maximum power energy of Microfluidic fuel cell	Jun Mo Han, Kang Ho Lee, Seung Woo Lee, Yoomin Ahn	Hanyang University
P-30	Development of Nanogap Biosensor for Cervical Cancer by HPV	Won Ick Jang, Han Young Yu, Yarkyeon Kim, Jeong Hyun Han, Nyeon-Sik Eum	ETRI
P-31	HIGH-THROUGHPUT AND LOW-COST FABRICATION OF POLYMER MICROSCANNER FOR LIGHTING APPLICATIONS	Haruyo Hashimoto, Kazuma Kurihara, Hideki Takagi, Ryutaro Maeda	AIST
P-32	Surface activated room-temperature direct bonding of Au electroplated patterns for heterogeneous integrationof MEMS	Yuichi Kurashima, Atsuhiko Maeda, Hideki Takagi	AIST
P-33	Introduction of the "Integrated Microsystems" project Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST)	Yuri Kitajima,Yuichi Ishikawa, Ryutaro Maeda	AIST
P-34	Room temperature wafer direct bonding using Si wafers smoothed by Ne beam surface treatments	Atsuhiko Maeda, Yuichi Kurashima, Hideki Takagi	AIST
P-35	Influence of Surface Pre-Pretreatment on Si Wafer Bonding at Low Temperatures	Ying-Hui Wang, TadatomoSuga	The University of Tokyo
P-36	Pressure-Controlled Variable Resistor for Limit Switch Applications	Yun-Jin Jeong, Jung-Ho Park, Yun-Jong Han, Dong-Weon Lee	Chonnam National University

The 4th Japan-China-Korea Joint Conference on MEMS/NEMS 2013

A Windmill-structured Electromagnetic Energy Harvester

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ABSTRACT

In this paper, we introduce a novel electromagnetic energy harvester with windmill-structure for low-power autonomous sensors. This design of the proposed energy harvester can effectively scavenge the energy from wind source based on the electromagnetic phenomenon. The windmill structure with four magnets can rotate in a high speed under wind excitation and thereby generate power efficiently through the coils nearby. A miniature energy harvester prototype is fabricated using 3D printing technique. In the performance testing experiment, a peak current of 299 mA and a peak output power of 418 mW are achieved within a high rotating speed range up to 4260 rpm. Moreover, a maximum V_{rms} of 117 mV is obtained on a driving car with a speed of 40 km/h, which could be potential power supply for wireless sensors network application.

Keywords : Energy harvesting, Electromagnetic, Windmill-structure, Wireless sensors network (WSN)

1. INTRODUCTION

In recent years, wireless sensors network (WSN) has been regarded as one of the most significant technologies in 21st century [1]. Unfortunately, the limited power of batteries in WSN applications will result in large amount of maintenance cost and mounting constrains [2]. Therefore, we propose a windmill-structured electromagnetic energy harvester to power the sensors in remote and harsh environment.

2. DESIGN AND EXPERIMENT

As shown in Fig. 1, during to the excitation caused by wind flow, the windmill structure will rotate and as a result, four end-magnets pass near the coils by turns. This structure can efficiently convert the wind energy into electricity. A prototype is fabricated utilizing 3D printing technology, which is shown in Fig. 2. The performance characterization is carried out in the experiment. It can be seen from Fig. 3 (a) and (b) that various pressures are applied on the energy harvester to test its output. With various applied pressure, a high rotating speed of 4260 rpm can be reached. Meanwhile, a peak output current of 299 mA and a peak output power of 418 mW are achieved, which are shown in Fig. 4-6. Additionally, as Fig. 7 and Fig. 8 shows, a maximum V_{rms} of 117 mV is obtained on a driving car with a speed of 40 km/h.

3. CONCLUSION

In this paper, we have presented the design, fabrication and characterization of an electromagnetic windmill-structured energy harvester which can effectively generate power under wind excitation. A maximum power of 418 mW is achieved, which fulfills the requirement of low-power autonomous sensors.

ACKNOWLEDGEMENT

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REFERENCES

1. I. F. Akyildiz, “Wireless sensor networks: a survey”, Comput. Netw., Vol. 38, pp. 393-422, 2002.
2. P. Constantinou, P. H. Mellor, and P. D. Wilcox, “A magnetically sprung generator for energy harvesting applications”, IEEE/ASME Trans. Mechatronics, Vol. 17, No. 3, pp. 415-424, 2012.

FIGURES

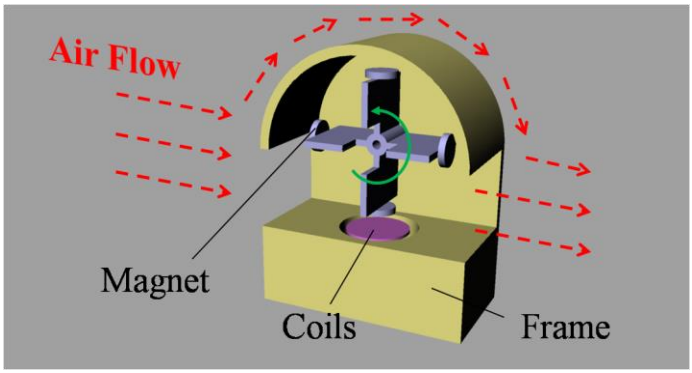

Fig. 1 The schematic of a windmill-structured energy harvester.

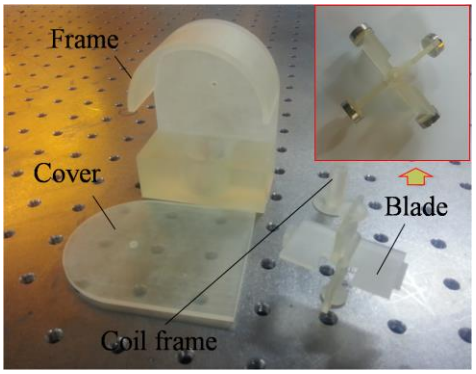

Fig. 2 The prototype of energy harvester fabricated by 3D printing technology.

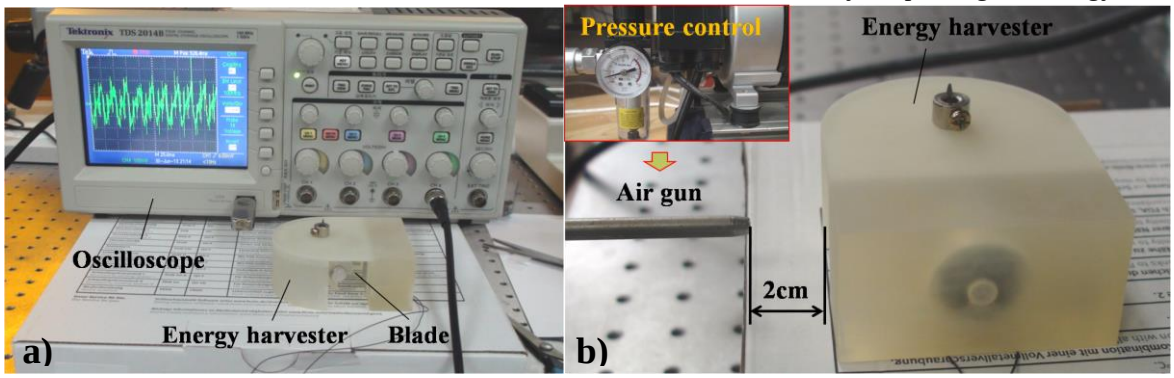

Fig. 3 Experiment setup: a) Utilizing the oscilloscope to test the output. b) Utilizing the air gun to apply pressure on the blades of energy harvester.

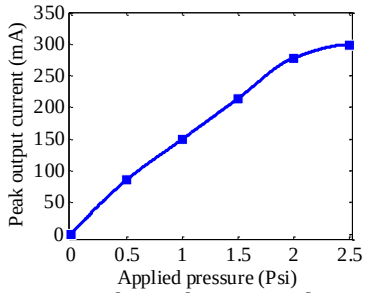

Fig. 4 The peak output voltage versus applied pressure.

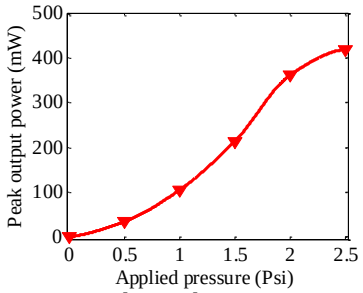

Fig. 5 The peak output power versus applied pressure.

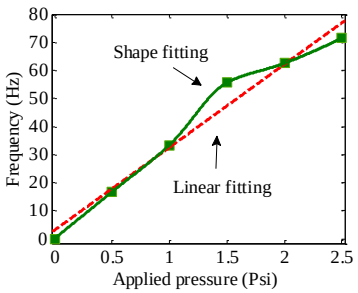

Fig. 6 The output frequency versus applied pressure.

Fig. 7 The output V_{rms} could be measured by a multimeter during car's driving.

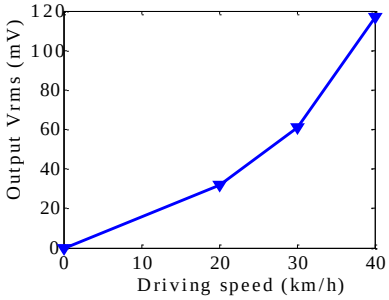

Fig. 8 The output V_{rms} versus the driving speed of a car.