THE FIBER SOCIETY

Advancing Scientific Knowledge
Pertaining to Fibers and Fibrous Materials

The Fiber Society 2012 Fall Meeting and Technical Conference

in partnership with

Polymer Fibres 2012

present

Rediscovering Fibers in the 21st Century

November 7–9, 2012

Conference Chairs

Stephen Eichhorn, University of Exeter
Cheryl Gomes, QinetiQ North America, Inc.
Gregory Rutledge, Massachusetts Institute of Technology

Venue

Boston Convention and Exhibition Center
Boston, Massachusetts, USA

Program

Tuesday, November 6

1:00 PM–5:00 PM	Governing Council Meeting, Room 160C
5:00 PM–6:00 PM	Early-Bird Registration and Reception, Room 102A

Wednesday, November 7

8:00 Registration and Continental Breakfast
8:40 Welcoming Remarks and Announcements *Gregory Rutledge, Stephen Eichhorn, Co-chairs*
Cheryl Gomes, Co-chair and President, Fiber Society

Morning Session

9:00	**Keynote Speaker: Ray H. Baughman, University of Texas at Dallas, USA** ***High-Performance, Electrolyte-Free Torsional and Tensile Carbon Nanotube Hybrid Muscles*** **(Room 104A)**

9:40	***Break (Room 102A)***

	Room 104A	**Room 104C**
	Session: Carbon Fibers and Composites ***Gregory Rutledge, Chair***	**Session: Thermal and Spectroscopic Properties** ***Janice Gerde, Chair***
10:00	*Use of Raman Spectroscopy to Resolve Analysis of Structure of Graphene-Coated Fibers* Ian R. Hardin and Susan Wilson, University of Georgia	*Atomic Force Microscope-Based Infrared Spectroscopy of Single Fibers* Michael Lo[1], Qichi Hu[1], Curtis Marcott[2], Craig Prater[1], and Kevin Kjoller[1], [1]Anasys Instruments Corp., [2]Light Light Solutions
10:20	*Carbon Fiber from Extracted Commercial Softwood Lignin* D.A. Baker, D.P. Harper, and T.G. Rials, University of Tennessee at Knoxville	*The Response of a Nylon-Cotton Fabric to High Heat Flux* Thomas Godfrey, Margaret Auerbach, Gary Proulx, Pearl Yip, and Michael Grady, U.S. Army Natick Soldier RDE Center
10:40	*Electrospun Carbon Nanofibers from Kraft Lignin* Omid Hosseinaei and Darren Baker, University of Tennessee at Knoxville	*A Study and a Design Criterion for Multilayer Structure in Perspiration-Based Infrared Camouflage* Xia Yin[1], Qun Chen[2], and Ning Pan[1], [1]University of California at Davis, [2]Tsinghua University
11:00	*Mesoporous Activated Carbon Nanofiber Synthesis from Catalytic Graphitization of Polyacrylonitrile/ Cobalt Sulfide Composite* Yakup Aykut[1], Behnam Pourdeyhimi[2], and Saad Khan[2], [1]Uludağ University, [2]North Carolina State University	*Thermal Protective Performance of Protective Clothing Upon Steam and Hot Liquid Splash* Farzan Gholamreza, Guowen Song, and Mark Ackerman, University of Alberta
11:20	*Electrically Conductive Fibers with Carbon Nanotubes: 3D Analysis of Conductive Networks by Electron Tomography* Wilhelm Steinmann, Johannes Wulfhorst, Thomas Vad, Gunnar Seide, Thomas Gries, Markus Heidelmann, and Thomas Weirich, RWTH Aachen University	*Thermal and Flame Retardant Behaviors of Cotton Fiber Treated with Phosphoramidate Derivatives* Thach-Mien Nguyen, SeChin Chang, and Brian Condon, U.S. Department of Agriculture

11:40	*Mechanical Properties of Composite Materials Made of Carbon Fiber Waste* Mehmet Emin Yuksekkaya, Mevlut Tercan, and Ayse Ceran Ucar, Usak University	*Characterization of Component Fibers in Military Textiles Using Pyrolysis-GCMS* Pearl Yip, U.S. Army Natick Soldier RDE Center
12:00	***Lunch On Your Own: Expo: Poster Setup (Room 102A)***	

Afternoon Session

1:30–2:45	**Student Paper Competition** **Room 104A** **Chair: Michael Ellison** Xianwen Mao, MIT: *Electrospun Carbon Nanofiber Webs with Controlled Density of States for Sensor Applications* Hua Zhou, Deakin University: *Durable Superhydrophobic Fabrics Prepared by Surface Coating of Nanoparticle/Elastomeric Polymer Composite* Xiaodan Zhang, Georgia Tech: *Flexible and Transparent Fiber-Based Ionic Diode Fabricated from Oppositely Charged Microfibrillated Cellulose*

2:45	***Break (Room 102A)***

3:00–3:40	**Keynote Speaker: Dr. Mary Boyce, Massachusetts Institute of Technology, USA** ***Mechanics of Nonwoven Fibrous Mats: Structure Evolution and Elastic-Plastic Deformation*** **(Room 104A)**	
	Room 104A	**Room 104C**
	Session: Clean Water/Clean Energy ***Konstantin Kornev, Chair***	**Session: Mechanical Properties** ***Stephen Eichhorn, Chair***
3:50	*Electrospun Nanofiber Derived TiO_2 Active Layer for Dye-Sensitized Solar Cell Applications* Xueyang Liu[1], Jian Fang[1], Mei Gao[2], and Tong Lin[1], [1]Deakin University, [2]CSIRO Materials Science and Engineering	*Developing an Environmentally Friendly Isothermal Bath to Obtain a New Class of High-Performance Fibers* H. Avci, H.J. Yoon, and R. Kotek, North Carolina State University
4:10	*Photovoltaic Fiber Having Polymer Anode and Inverted Layer Sequence* İ. Borazan[1], A. Bedeloğlu[2], and A. Demir[1], [1]İstanbul Technical University, [2]Dokuz Eylül University	*The Mechanics and Tribology of Electrospun PA 6(3)T Fiber Mats* Matthew Mannarino and Gregory Rutledge, MIT
4:30	*Optimizing Fiber-Based Bioconversion Media for Ammonia/Water Bio-Remediation* Yong Kim and Armand Lewis, University of Massachusetts at Dartmouth	*On the Design Method of Lightweight Construction Materials: Structural Characteristics-Tearing Strength Relationship* Yusuf Ulcay[1,2] and Fatih Suvari[1], [1]Uludağ University, [2]Bursa Technical University
4:50	*3D Woven Fabrics as Filtration Media in a Membrane Bioreactor for Wastewater Treatment* Fang Zhao, Bubi Jing, Hong Chen, Fujun Xu, Lan Yao, and Yiping Qiu, Donghua University	*Continuous Dynamic Analysis: Evolution of Storage and Loss Modulus in Fibers as a Function of Strain* Sandip Basu and Jennifer Hay, Agilent Technologies

5:20–7:00 **Poster Session and Reception (Room 102A)**

Thursday, November 8

8:00 Continental Breakfast (Room 102A)

Morning Session

9:00	**Keynote Speaker: Dr. David Weitz, Harvard University, USA** ***Biopolymer Networks: How Fiber Structures Provide Rigidity to the Cell*** **(Room 104A)**

9:40	***Break (Room 102A)***

	Room 104A	**Room 104C**
	Session: Natural Fibers ***Ian R. Hardin, Chair***	**Session: Surface Properties** ***Michael Ellison, Chair***
10:00	*Soybean Biorefinery Model: Nanofibers, Nanocomposites, Green Composites and More* Anil Netravali, Cornell University	*Butterfly-Inspired Fiber-Based Nanofluidics* Konstantin Kornev, Clemson University
10:20	*Self-Assembled Nanostructures from Cellulose Nanocrystals* You-Lo Hsieh, University of California at Davis	*Theoretical and Experimental Investigation of Non-Rotationally Symmetrical Droplets on Fibers* Jintu Fan[1,2], Maofei Mei[1], and Dahua Shou[1], [1]Hong Kong Polytechnic University, [2]Cornell University
10:40	*Orientation of Cellulose Nanofibers Using Magnetic Fields and Wet-Stretching* Stephen Eichhorn[1], Arthur Wilkinson[2], and Tanittha Pullawan[2], [1]University of Exeter, [2]University of Manchester	*Optimization of Breathable Waterproof Coating Conditions for Minimizing Fabric Frictional Sound of Korean Military Combat Uniform Fabrics* Kyulin Lee and Gilsoo Cho, Yonsei University
11:00	*Electrospinning Hyaluronic Acid* Caroline Schauer and Laura Toth, Drexel University	*Textile Functional Coloration to Offer Photo-Induced Surface Functions* Gang Sun, Jingyuan Zhou, and Ning Liu, University of California at Davis
11:20	*Structure and Mechanical Properties of Silk-Inspired Flow-Assembled Fibers* Seunghwa Ryu[1], Greta Gronau[1], Michelle Kinahan[2], Sreevidhya Krishnaji[3,4], David Kaplan[3], Joyce Wong[2], and Markus Buehler[1], [1]MIT, [2]Boston University, [3]Tufts University	*Comparison of Color Properties of CO_2 Laser-Treated Cotton Polyester-Blended Fabric Before and After Dyeing* O.N. Hung, C.K. Chan, C.W. Kan, and C.W.M. Yuen, Hong Kong Polytechnic University
11:40	*Submicron Fiber Nonwovens from Ingeo®, a Sustainable Polymer* Gajanan Bhat[1], Kokouvi Akato[1], and Robert Green[2], [1]University of Tennessee at Knoxville, [2] Nature Works	*Development of a Novel Bicomponent Fiber-Based PET/PE Composite with Improved Interface and Mechanical Performance* Mehmet Dasdemir[1], Benoit Maze[2], Nagendra Anantharamaiah[3], and Behnam Pourdeyhimi[2], [1]University of Gaziantep, [2]North Carolina State University, [3]Hollingsworth & Vose

12:00	***Lunch On Your Own; Expo***

Afternoon Session

1:30	**Keynote Speaker: : Dr. Andy Alderson, University of Bolton, UK** ***Auxetic Fibres: History, Applications, and Future Perspectives*** ***(Room 104A)***

2:10	***Break (102A)***

	Room 104A	**Room 104C**
	Session: Biology and Health ***Caroline Schauer, Chair***	**Session: Fiber Processing** ***Rudolf Hufenus, Chair***
2:30	*Green Engineering of Antimicrobial Nanofiber Mats* Jessica Schiffman, Katrina Rieger, Nathan Birch, and Nathaniel Eagan, University of Massachusetts at Amherst	*SiC Fiber Made with Aqueous Binder by Melt Spinning* Alex Lobovsky and Mohammad Behi, United Materials Technologies
2:50	*Antimicrobial Finishing of Polyester and Cotton Fabrics* Idris Cerkez, S.D. Worley, and R.M. Broughton, Auburn University	*High-Performance Polyimide Fibers Prepared by Dry Spinning Technology* Qinghua Zhang, Yuan Xu, Jie Dong, Chaoqing Yin, Shihua Wang, and Dajun Chen, Donghua University
3:10	*The Effect of Needlepunched Nonwoven Fabric on Controlling Hyperhydricity of Scutellaria Species In Vitro Liquid Culture Systems* M. Taşcan[1], J. Adelberg[2], A. Taşcan[1], N. Joshee[3], and A.K. Yadav[3], [1]Zirve University, [2]Clemson University, [3]Fort Valley State University	*High-Throughput Needleless Electrospinning of Core-Sheath Fibers* Toby Freyman[1], Xuri Yan[1], Quynh Pham[1], John Marini[1], Robert Mulligan[1], Upma Sharma[1], Michael Brenner[2], and Gregory Rutledge[3], [1]Arsenal Medical, [2]Harvard University, [3]MIT
3:30	*Amidoximated Bacterial Cellulose as an Effective Nanoreactor for In Situ Synthesis of ZnO Nanoparticles* Weili Hu, Shiyan Chen, Bihui Zhou, and Huaping Wang, Donghua University	*Coaxial-Free Surface Electrospinning* Keith Forward[1,2], Alexander Flores[1], and Gregory Rutledge[1], [1]MIT, [2]California State Polytechnic University
3:50	*Textile Heart Valve Prosthesis: Early In Vitro Fatigue Performances* Frederic Heim[1], Bernard Durand[1], and Nabil Chakfe[2], [1]ENSISA, [2]Hôpitaux Universitaires de Strasbourg	*Developing Real-Time Control for Electrospinning of Nanofibers: Evaporation and Measurement Considerations for Aqueous and Non-Aqueous Solutions* Michael Gevelber, Yunshen Cai, Thierry Desire, and Xuri Yan, Boston University
4:10	*Investigation into New 3D Fibrous Structure for Soles Application* Mouna Messaoud[1], Antoine Vaesken[1], Laurence Schacher[1], Dominique Adolphe[1], Jean-Baptiste Schaffhauser[2], and Patrick Strehle[2], [1]ENSISA, [2]N. Schlumberger	*Electro-Centrifugal Nanofiber Spinning* Tao Huang, Jack Armantrout, Kevin Allred, and Thomas Daly, DuPont
4:30	*Property Evaluation of Diabetic Socks Used to Prevent Diabetic Foot Syndrome* M.J. Abreu, A. Catarino, and O. Rebelo, University of Minho	*Governing Equations for the Well-Enchanced Electro-Centrifuge Spinning Process* Seyed Hosseini Ravandi, Afsaneh Valipouri, and Admadreza Pishevar, Isfahan University of Technology
5:00– 6:00	**Fiber Society General Body Meeting (Open to Fiber Society Members Only)** **Room 104A**	

6:00 **Reception (Room 104B)**

6:30–10:00 **Banquet and Awards Ceremony**
Ms. Shevy Rockcastle, KVA Kennedy & Violich Architecture
Going Soft: Textiles and Resilient Architecture

Friday, November 9

8:00 Continental Breakfast (Room 102A)

9:00	**Keynote Speaker: Dr. John F. Rabolt, University of Delaware, USA** ***Preparation and Characterization of Multilayer Polymer Nanofibers by Multiaxial Electrospinning*** **(Room 104A)**

9:40	***Break (Room 102A)***

	Room 104A	**Room 104C**
	Session: Nanofibers ***Michael Jaffe, Chair***	**Session: Sensors and Electrical Properties** ***Phillip Gibson, Chair***
10:00	*A Historical Perspective on Nanofibers: Can We Make It More Relevant?* H. Young Chung, Et Esus	*Base Fiber Technologies for Smart Textiles* R. Hufenus, D. Hegemann, S. Gaan, F.A. Reifler, and L.J. Scherer, Empa
10:20	*Electrospun Nanofibers Functionalized with Cyclodextrins and Their Potential Applications* Tamer Uyar, Asli Celebioglu, Fatma Kayaci, Zeynep Aytac, and Yelda Ertas, Bilkent University	*Functional Fibers for Integrated Sensing and Actuation* Ton Peijs[1,2], Oliver Picot[1], Mian Dai[2], Nanayaa-Hughes Brittain[1], Emiliano Bilotti[1], and Cees Bastiaansen[1,2], [1]Queen Mary University of London, [2]Eindhoven University
10:40	*Spinning Functional PLA Nanofibers for Controlled Release, Protein Capture, and Sensing* Margaret Frey[1], Dapeng Li[1,2], Chunhui Xiang[1,3], and Ebru Buyuktanir[4,5], [1]Cornell University, [2]University of Massachusetts at Dartmouth, [3]Iowa State University, [4]Kent State University, [5]Stark State University	*Mechanical and Electrical Properties of Polyamide 66 Nanocomposites Reinforced with Buckminster Fullerene C60* Reyhan Keskin[2], Ikilem Gocek[1], Guralp Ozkoc[3], Koray Yilmaz[2], and Yunus Kamac[2], [1]İstanbul Technical University, [2]Pamukkale University, [3]Kocaeli University
11:00	*Electrospinning of Reactive Mesogens* Ton Peijs[1,2], Jian Yao[1], and Kees Bastiaansen[1,2], [1]Queen Mary University of London, [2]Eindhoven University	*Production of Polymer Filament-Shaped Piezoelectric Sensors for E-Textiles Applications* H. Carvalho[4], R.S. Martins[1], R. Gonçalves[2], J.G. Rocha[3], J.M. Nóbrega[1], S. Lanceros-Mendez[2,5], [1]Institute for Polymers and Composites, [2]Centro/Departamento de Física, [3]Dep. Industrial Electronics, [4]University of Minho, [5]International Iberian Nanotechnology Laboratory
11:20	*Characterization of Compressive Properties of Electrospun Mats* Looh Tchuin Choong and Gregory Rutledge, MIT	*Chemical Resistance of Poly(3,4-ethylenedioxythiophene) on Textiles* Christopher DeFranco, Qinguo Fan, and Jinlin Cai, University of Massachusetts at Dartmouth

11:40	*Fabrication of Composite Polyallylamine-Nanodiamond Fibers* Marjorie Kiechel, Ioannis Neitzel, Vadym Mochalin, Yury Gogotsi, and Caroline Schauer, Drexel University	*Tunable Force Sensor Based on Flexible Polymeric Optical Fibres* Marek Krehel[1,2], René Rossi[1], Gian-Luca Bona[1,2], and Lukas Scherer[1], [1]Empa, [2] ETH Zurich

12:00	**Close of Conference: Room 104A**

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Poster Presentations

Session Chair: ***Stephen Michielsen***
Room 102A

Zachary Dilworth	*3D Volume Representation of Nanowebs*
Carole Winterhalter	*Comparison of Evaporative Resistance of Carbon-Based Chemical Protective Undergarments*
Yusuf Ulcay	*Preparation and Characterization of Poly(ethylene terephthalate)/Nanoclay Nanocomposites Fibers*
Larissa Buttaro	*Phase Separation to Create Hydrophilic Yet Nonwater Soluble PLA/PLA-b-PEG Fibers via Electrospinning*
Meryem Pehlivaner	*The Effects of Solvents on the Morphology and Conductivity in PEDOT:PSS / PVA Nanofibers*
Laura Toth	*Chitosan Fiber Scaffolds for Craniofacial Bone Tissue Engineering*
Fuan He	*Preparation and Characterization of Organosilicate-Reinforced Electrospun Membrane*
Eliza Allen	*Incorporation and Performance of Molecular Polyoxometalates in Cellulose Substrates*
Zhang Jiang	*Nanoconfinement-Induced Enhancement of Thermal Energy Transport Efficiency in Electrospun Polymer Nanofibers*
Yunfei Han	*Reactivity of Methyl Parathion Degradation with Immobilized Zinc Oxide Nanoparticles*
Helder Carvalho	*Surface Electromyography Using Textile-Based Electrodes*
Seyed Ravandi	*Physical Properties of PLGA Nanofiber Yarn with Potential Application Surgical Suture*
Kaiyan Qiu	*Biodegradable Polymer Nanocomposites Using Polyvinyl Alcohol and Nanomaterials*
Yunshen Cai	*Real-Time Control for Electrospun Nanofiber: Experimental Investigation of Electrospinning Physics*

Judith Sennett	*Environmental Aging Study of AuTx® and Kevlar® Yarns and Fabrics*
Phillip Gibson	*A Design Tool for Clothing Applications: Wind Resistant Fabric Layers*
Hua Zhou	*Durable Superhydrophobic Fabrics Prepared by Surface Coating of Nanoparticle/Elastomeric Polymer Composite*
Xianwen Mao	*Electrospun Carbon Nanofiber Webs with Controlled Density of States for Sensor Applications*
Xiaodan Zhang	*Flexible and Transparent Fiber-Based Ionic Diode Fabricated from Oppositely Charged Microfibrillated Cellulose*
Laura Lange	*Polyacrylonitrile-Metal Organic Framework (MOF) Composite Electrospun Nanofibers Designed to Remove Chemical Warfare Agent Simulants from a Solution*
Yehu Lu	*A New Approach to Evaluate Performance of Protective Material Upon Hot Liquid Splash*
Liliana Fontes	*Thermal and Comfort Measurements of Mattress Protectors Used for Prevention of Pressure Ulcers*
Hu Zhang	*The Influence of Copper (II) Ions on Wool Photostability in the Dry State*
David Branscomb	*Open-Architecture Composite Tube: Design and Manufacture*

Surface Electromyography Using Textile-Based Electrodes

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ABSTRACT
Surface Electromyography (sEMG) is a fundamental method for study the biomechanical behavior of a person, allowing the extraction of valuable information for health professionals. This paper presents a research conducted with the purpose of developing textile electrodes for non invasive surface electromyography. Conducting fibers were used in a specifc arrangement taking into consideration SENIAM recommendations and embedded in a textile fabric. A comparison was made between conventional electrodes and the proposed ones. The results showed that the behavior is similar, which can constitute a valid alternative, overcoming some disadvantages such as the comfort for the user.

KEYWORDS: surface electromyography, textile electrodes

INTRODUCTION

There are two possible approaches for measuring the muscular activity through electromyography (EMG): invasive and non invasive. While the former basically use intramuscular needles which allow to measure internal muscles and identify a smaller number of motor units (muscular cell), the latter is applied on top of the muscle, in direct contact with skin, thus allowing to measure muscles that are at the surface and grouping in the resulting signal several motor units. Regarding the non invasive approach, conventional electrodes are available in rigid and non rigid forms, and are attached directly on top of the muscle that is intended to be monitored. The attachment generally made using adhesive tape or similar. With the purpose of improving the user's comfort, the research team proposed in previous works [1,2] to develop textile electrodes embedded in the fabric, easy to wear and getting similar results to conventional electrodes. There are several studies made regarding textile based electrodes, mainly for ECG applications, as it is mentioned by [3]. The technologies generally used involve weft knitting [1-4], woven fabrics and embroidery applications [5]. The use of textile electrodes rise questions like the skin-electrode impedance since they are heterogeneous and form a very complex structure in terms of electrical impedance associations. There are textile structures that present better results than others.

Concerning sEMG, the capacitive principle is presented by [5], while [4] prefer the traditional method of direct contact with skin.

Since the electrodes are textile structures, the raw material is also matter of concern and study, as mentioned by [1, 6]. Not all the conductive materials may be the most adequate, as stated in [6,7], suggesting the use of stainless steel fibers and multifilament yarns, instead of silver. The problem of stabilization in place is generally tackled by means of using compression garments, instead of adhesives.

ELECTRODE FABRICATION

There are some technologies available for producing the structure that will form the electrode. Weft knitting was selected, since it presents some advantages, such as only one conductive yarn is enough to build the electrode. It was decided to use a seamless knitting machine, since it is specially designed to produce body wear garments. Another important feature is the fact that these machines are full jacquard, which allows placing the electrode in any location and with the shape and structure desired. In order to obtain compression, the fabrics with embedded electrodes were produced also with bare elastane together with the base yarn polyamide.

Not all conductive yarns are adequate for knitting. The mechanical properties play an important role, since the operations involved during knitting will make the yam to bend, suffer significant stress, among other effects. The yarn may be so strong and abrasive that will destroy the base yarn and the elastane. From the conductive yarns available, the team selected two yarns: a blend made of 80% polyester and 20% stainless steel, also known as Bekitex BK, and identified as yarn FA; a multifilament yarn made with 80% of silver-covered polyamide and 20% elastane, known as Elitex, identified in the experiments as yarn FB. Several structures were made based on knit, tuck and float variations with the purpose of identifying which was the one that provides a stronger signal. From those experiments one found that a combination of float and knit loops provide a structure more reliable in terms of signal strength and reliability. Figure 1 illustrates a version of those electrodes. These specific electrodes have the dimension of 3.5x4.0 cm (A) and 3.8x4.3 cm (B).

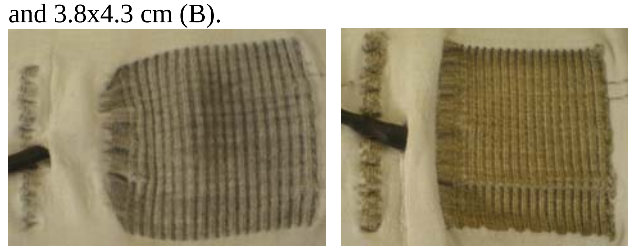

Figure 1. Textile electrodes with FA yarn (left) – electrode A; and FB yarn (right) – electrode B.

In order to compare the textile with conventional electrodes, used in sEMG, a version of textile electrodes was produced taking into consideration SENIAM recommendations. These electrodes, illustrated in Figure

2, present the dimensions of 4.0 cm length and 0.5 and 0.3 cm height, respectively. The distance between electrodes is 2.0 cm.

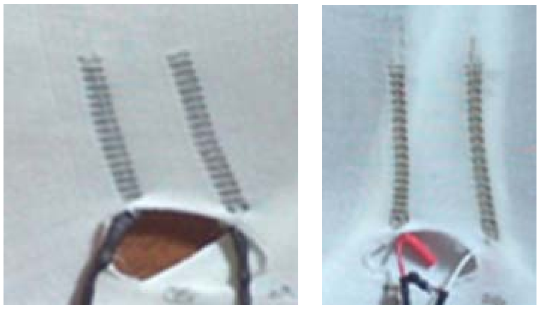

Figure 2. sEMG Electrodes C (left) and D (right), based on yarns FA (left) and FB (right).

RESULTS AND DISCUSSION

As mentioned before, the main objective of this work was the comparison of textile based electrodes with conventional electrodes, made with Ag/AgCl. Two kinds were tested: one with a spoon shape and diameter 1.0 cm and flexible disposable electrodes in a with 2.6x2.0 cm.

To determine the skin-electrode interface impedance, the electrodes were submitted to signals from 5 to 600 Hz, which accommodate the frequencies of interest for EMG. Figure 3 shows the behavior of textile electrode type B, which was found to be very similar to the conventional electrodes tested. The remaining electrodes showed similar results.

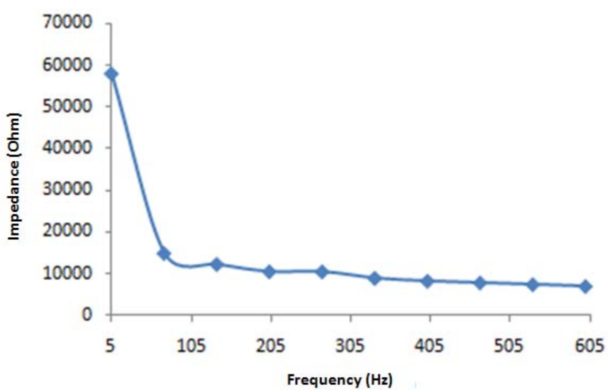

Figure 3. Skin-electrode impedance for electrode B.

Figures 4 to 7 present the resulting waveforms for conventional and textile based electrodes. All electrodes were used in pairs, together with a reference electrode, placed in the *byceps*. As it can be seen, the signals show a similar shape, signal to noise ratio and RMS signals with a signal correlation above 95%. It is very clear the difference between rest and contracting the muscle.

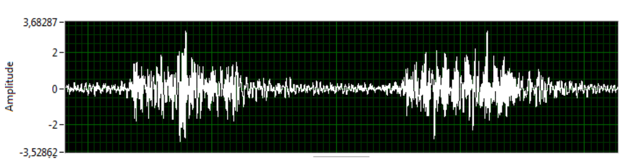

Figure 4. sEMG for Ag/AgCl spoon-shape electrode with conductive gel.

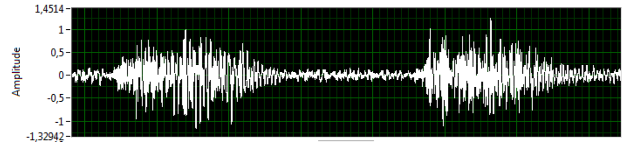

Figure 5. sEMG for Ag/AgCl membrane electrode with conductive gel.

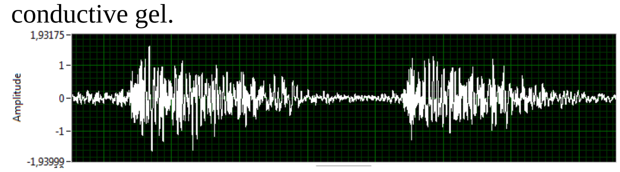

Figure 6. sEMG for electrode C with conductive gel.

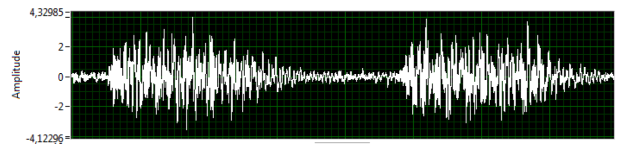

Figure 7. sEMG for electrode D with conductive gel.

CONCLUSIONS

This work presented textile based electrodes for use on sEMG. The fabrication process allows embedding the electrodes in the fabric, placed in any location, and a customized shape. The experiments made showed that the electrode's structure has influence in the signal quality. Comparing to conventional electrodes, it was observed signals with similar results. The advantage of more comfort to the user, since there is no need for adhesive, makes them a valid alternative that needs to be further explored.

REFERENCES

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