

## Helmi-Marja Kaisu Keskinen

March 24th, 1978 born in Tampere, Finland

### *Education*

2007 PhD Major: Technical Physics. Minor: Energy and Process Engineering.  
"Synthesis of Nanoparticles and Preparation of Deposits by Liquid Flame Spray"  
(degree: 5; **excellent**)  
advisor: Docent Jyrki Mäkelä, opponent: Professor Jorma Jokiniemi

2002 MS Major: Material chemistry. Minor: Technical Physics.  
"Formation and Properties of Nanoparticles Produced by Liquid Flame Spray"  
advisors: Docent Jyrki Mäkelä and Professor Helge Lemmetyinen

### *Work experience*

2007-2009, Post-doc researcher at Tampere University of Technology and research exchange (co-operation funded by Finnish academy and Finnish Technology Agency and ETH Zürich fellowship) at ETH/ Particle Technology Laboratory

2002, 2004-2007, Post graduate researcher and assistant teacher at Tampere University of Technology, Finland

2003, Post graduate researcher (scholarship from Finnish Academy) at the Czech Republic Science Academy, Czech Republic

2000-2001, Research assistant, Tampere University of Technology, Finland

6-8/1997, Assistant in environmental protection department, City of Joensuu, Finland

### *Referred Publications*

1. Keskinen, H., Tricoli, A., Marjamäki, M., Mäkelä J. M. and Pratsinis, S. E. (2009). "Size-selected agglomerates of SnO<sub>2</sub> nanoparticles as gas sensors." *J. Appl. Phys.* 106, 084316.
2. Nikkanen, J. P., Keskinen, H., Aromaa, M., Järn, M., Kanerva, T., Levänen, E., Mäkelä, J. M. and Mäntylä, T. (2008). "Iron oxide doped alumina-zirconia nanoparticle synthesis by Liquid Flame Spray (LFS) from metal organic precursors." *Res. Lett. Nanotech.* ID 516478, (4 pp), DOI:10.1155/2008/516478.
3. Keskinen, H., Aromaa, M., Heine, M. C. and Makela, J. M. (2008). "Size and velocity measurements in sprays and particle-producing flame sprays." *Atomizat. Sprays* **18**(7): 619-644.
4. Sainiemi, L., Keskinen, H., Aromaa, M., Luosujarvi, L., Grigoras, K., Kotiaho, T., Makela, J. M. and Franssila, S. (2007). "Rapid fabrication of high aspect ratio silicon nanopillars for chemical analysis." *Nanotech.* **18** ID 505303 (7pp DOI: 10.1088/0957-4484/18/50/505303
5. Moravec, P., Smolik, J., Keskinen, H., Makela, J. M. and Levdansky, V. V. (2007). "ZrO<sub>2</sub>/SiO<sub>2</sub> fine particle synthesis by MOCVD." *CVD* **13**: 474-480.

6. Moravec, P., Smolik, J., Keskinen, H., Makela, J. M. and Levdansky, V. V. (2007). "Vapor phase synthesis of zirconia fine particles from zirconium tetra-tert-butoxide." *Aerosol Air Qual. Res.* **7**: 563-577.
7. Keskinen, H., Makela, J. M., Heikkinen, R., Suopanki, A. and Keskinen, J. (2007). "Synthesis of Pd-alumina and Pd-lanthana suspension for catalytic applications by one-step liquid flame spray." *Catal. Lett.* **119**: 172-178.
8. Keskinen, H., Makela, J. M., Aromaa, M., Ristimäki, J., Kanerva, T., Levanen, E. and Mantyla, T. (2007). "Effect of silver addition on the formation and deposition of titania nanoparticles produced by liquid flame spray." *J. Nanoparticle Res.* **9**(4): 569-588.
9. Aromaa, M., Keskinen, H. and Makela, J. M. (2007). "The effect of process parameters on the Liquid Flame Spray generated titania nanoparticles." *Biomolec. Eng.* **24**: 543-548.
10. Keskinen, H., Makela, J. M., Aromaa, M., Keskinen, J., Areva, S., Teixeira, C. V., Rosenholm, J. B., Pore, V., Ritala, M., Leskela, M., Raulio, M., Salkinoja-Salonen, M. S., Levanen, E. and Mantyla, T. (2006). "Titania and titania-silver nanoparticle deposits made by Liquid Flame Spray and their functionality as photocatalyst for organic- and biofilm removal." *Catal. Lett.* **111**(3-4): 127-132.
11. Pitkänen, A., Mäkelä, J. M., Nurminen, M., Oksanen, A., Janka, K., Keskinen, J., Keskinen, H., Liimatainen, J. K., Hellsten, S. and Määttä, T. (2005). "Numerical study of silica particle formation in turbulent H<sub>2</sub>/O<sub>2</sub> flame " *IRFR Combust. J.* ID 200509: 1-29.
12. Keskinen, H., Moravec, P., Smolik, J., Levdansky, V. V., Makela, J. M. and Keskinen, J. (2004a). "Preparation of ZrO<sub>2</sub> fine particles by CVD process: Thermal decomposition of zirconium tert-butoxide vapor." *J. Mater. Sci.* **39**(15): 4923-4929.
13. Keskinen, H., Mäkelä, J. M., Vippola, M., Nurminen, M., Liimatainen, J., Lepisto, T. and Keskinen, J. (2004). "Generation of silver/palladium nanoparticles by liquid flame spray." *J. Mater. Res.* **19**(5): 1544-1550.
14. Makela, J. M., Keskinen, H., Forsblom, T. and Keskinen, J. (2004). "Generation of metal and metal oxide nanoparticles by liquid flame spray process." *J. Mater. Sci.* **39**(8): 2783-2788.

### *Referred Proceedings*

- I. Moravec P., Smolík J., Levdansky V.V., Keskinen H. CVD Synthesis of Multicomponent Nanosized Particles in an Externally Heated Tube Flow Reactor. (Eng) In: Nanostructured Materials and Their Applications. (Szymanski, W.W. - Wagner, P.E. - Itoh, M., Ed.), pp. 9-19, Facultas Verlags, Wien 2004.
- II. Keskinen H., J.M. Mäkelä S. Hellsten, M. Aromaa, E. Levänen and T. Mäntylä Generation of Titania Nanoparticles by Liquid Flame Spray for Photocatalytic Applications, reviewed paper to EUROCV-15, Electrochemical Soc. Proceedings Vol. 2005-09, pp. 491-498, Bochum 2005.

## *Easy-to-understand articles and interviews*

- 18.6.2007 Interview (direct) (7 min) by Seppo Lehtonen to YLE Tampere radio 'Easy-to-clean titania surfaces'  
Article in *Tekhnä* (Vol 3; 2007) by Suvi Vuorinen (from interview)  
'Nanoteknologiastako apua kodin siivoukseen?'

## *Grants*

- 2003 Finnish Academy of Science and Letters: traveling grant for four months to Czech Republic Science Academy, Finnish Academy: researcher exchange program with Finnish Academy and Czech Republic Science Academy for four months  
2004 Finnish Academy of Science and Letters: scholarship for six months (1.4.-30.9.2004)  
2005 Finnish Academy of Science and Letters: traveling grant for two weeks to Czech Republic Science Academy, Gesellschaft für Aerosolforschung (GAeF) -Association for Aerosol Research, Travel grant for European Aerosol Conference  
2006 Finnish Academy of Science and Letters: Travel grant for two weeks to Czech Republic Science Academy  
2007-2008 Finnish Academy: scholarship for post-doc research exchange to ETH, Zürich  
2009 Fellowship ETH Zürich

## *Professional societies*

- 2002- Finnish Association for Aerosol research  
2002- The association of Finnish Chemical Societies  
2004- Association for Aerosol Research  
2005- American Institute of Chemical Engineering  
2005- Material Research Society

## *Presentations*

1. Keskinen, H., Mäkelä J.M., Liimatainen J.K., Nurminen M. and Keskinen J., Generation of Palladium Nanoparticles by LFS for Catalytic Applications, Czech-Finnish aerosol symposium, Prague, Czech republic, May 2002.
2. Mäkelä, J.M., Pirilä N., Keskinen H., Liimatainen J.K., Nurminen M., Janka K. and Keskinen J. Silica Nanoparticle Generation from TEOS by Liquid Flame Spray, Abstract to Check-Finish aerosol symposium Prague, Czech republic, May 2002.
3. Moravec, P., Smolik J., Levdansky V.V. and Keskinen H. CVD Method Synthesis of Multicomponent Fine Particles in an Externally Heated Tube Flow Reactor, Nano-Structured Materials- Fundamentals and Applications, Vienna, Austria, June 2002.
4. Moravec, P., Smolik J., Levdansky V.V. and Keskinen H. CVD Synthesis of Heterostructure Fine Particles by CVD Method in a Tube Flow Reactor, NANO '02 Nanoscience and Nanotechnology Section, Brno, Czech Republic, December 2002.
5. Mäkelä, J.M., Pirilä N., Keskinen H., Liimatainen J.K., Nurminen M., Janka K. and Keskinen J. Generation of Silica Nanoparticles for Optical Waveguide Applications, International Aerosol Conference, Taipei, Taiwan, September 2002.
6. Janka, K., Rajala, M., Kykkänen, P., Mäkelä J.M., Keskinen, H., Liimatainen, J., Nurminen, M. & Keskinen, J. An industrial method for nanoparticle synthesis with wide range of compositions, International Conference on Nanomaterials and Nanotechnologies, Creta, Greece, September 2003.

7. Nurminen, M., Mäkelä J.M., Keskinen H., Liimatainen J.K., Pitkänen A., Oksanen A., Janka K. and Keskinen J. Study on Silica Nanoparticle Formation from TEOS in Turbulent O<sub>2</sub>-H<sub>2</sub> Flame, European Aerosol Conference, Madrid, Spain, August 2003.
8. Moravec P., Smolik J., Levdansky V.V. and Keskinen H. Synthesis of Zirconia Fine Particles by Vapour-Phase Decomposition of Zirconium *tert*-Butoxide, European Aerosol Conference, Madrid, Spain, August 2003.
9. Keskinen, H., Mäkelä J.M., Forsblom T. and Keskinen J. Metal and metal oxide nanoparticle synthesis by liquid flame spray, The 9<sup>th</sup> Finnish National Aerosol Symposium, Helsinki, Finland, March 2004.
10. Moravec, P., Smolik J., Levdansky V.V., Keskinen H. and Mäkelä J.M. (2004) Factors determining ZrO<sub>2</sub> nanoparticle formation by thermal decomposition of Zirconium *tert*-Butoxide in a tube flow reactor, European Aerosol Conference, Budapest, Hungary, September 2004.
11. Keskinen, H., Mäkelä J.M., Vippola M., Nurminen M., Liimatainen J.K., Lepistö T., and Keskinen J. Binary metal alloy nanoparticles synthesis by Liquid Flame Spray, European Aerosol Conference, Budapest, Hungary, September 2004.
12. Keskinen, H. Mäkelä J.M., Aromaa M., Keskinen J, Levänen E and Mäntylä T. Effect of Silver Doping on Titania Nanoparticles Produced by Liquid Flame Spray, European Aerosol Conference, Ghent, Belgium, September 2005.
13. Moravec, P., Smolik J., Levdansky V.V., Keskinen H. and Mäkelä J.M. ZrO<sub>2</sub>-SiO<sub>2</sub> fine particle formation in an externally heated tube reactor by CVD method. (2005), Abstract to European Aerosol Conference, Ghent, Belgium, September 2005.
14. Keskinen, H., Mäkelä, J.M., Hellsten, S., Aromaa, M., Levänen, E. & Mäntylä, T., Generation of titania nanoparticles by liquid flame spray for photocatalytic applications. Abstract to EUROCVT-15, Fifteenth European Conference on Chemical Vapor Deposition, Bochum, Germany, September 2005.
15. Keskinen, H. Mäkelä J.M., Aromaa M., Levänen E., Mäntylä T. and Keskinen J. Two-component metal-metal and ceramic-metal nanoparticle synthesis by Liquid Flame Spray. Abstract to AIChE (American Institute of Chemical Engineers) Annual Meeting, Cincinnati, Ohio, USA, November 2005.
16. Moravec, P., Smolik J., Levdansky V.V., Keskinen H. and J.M. Mäkelä (2005) Production of Composite ZrO<sub>2</sub>-SiO<sub>2</sub> Fine Particles by Thermal Decomposition of Zirconium Tetra-*tert*-butoxide and Tetraethyl orthosilicate in an Externally Heated Tube Reactor, Abstract to Czech National Aerosol Society Annual conference, Prague, pp. 27-30, November 2005.
17. Keskinen, H., Mäkelä J.M., Aromaa M., Keskinen J., Areva S., Cilaine V. T., Rosenholm J.B., V Pore V., Ritala M., Leskelä M., Raulio M., Salkinoja-Salonen M.S., Levänen E. and Mäntylä T., Liquid Flame Spray Made Titania and Titania-Silver Nanoparticle Deposits Functionality as Photocatalyst for Organic- and Biofilm Removal, World Congress on Particle Technology, Lake Buena Vista, Florida, USA, April 2006.
18. Keskinen, H. Mäkelä J.M., Aromaa M., Levänen E., Mäntylä T. and Keskinen J. Liquid flame spray made silver, titania and titania-silver nanoparticle deposits, International Aerosol Conference, St. Paul, Minnesota, USA, August 2006.
19. Aromaa, M., Keskinen, H. and Mäkelä, J.M. (2006). The Effect of Process Parameters on the Liquid Flame Spray Generated Titania Nanoparticles, European Materials Research Society Fall Meeting, Warsaw, Poland September 2006.
20. Aromaa, M. Keskinen, H. and Mäkelä, J.M.. Generating Titanium Dioxide Nanoparticles Using the Liquid Flame Spray – Modifying Particle Size and Phase Composition, NOSA 2006 Aerosol Symposium, Helsinki, Finland, November 2006.
21. Keskinen, H., Mäkelä J.M., Aromaa M., Keskinen J., Areva S., Cilaine V. T., Rosenholm J.B., V Pore V., Ritala M., Leskelä M., Raulio M., Salkinoja-Salonen M.S., Levänen E. and Mäntylä T. (2006). Liquid Flame Spray Made Titania and Titania-Silver Nanoparticle Deposits Functionality as Photocatalyst for Organic- and Biofilm Removal, NOSA 2006 Aerosol Symposium, Helsinki, Finland, November 2006.
22. Keskinen, H., J. M. Mäkelä, M. Aromaa, M. Heine and S.E. Pratsinis, Characterization of droplet atomization in cold and hot spray, International Congress on Particle Technology, Nuremberg, Germany, March 2007.
23. Keskinen, H., J. M. Mäkelä, R. Heikkinen and J. Keskinen, Porous catalytic material suspension synthesis in one-step by Liquid Flame Spray, International Congress on Particle Technology, Nuremberg, Germany, March 2007.

24. Keskinen, H., J. M. Mäkelä, M. Aromaa, J. Keskinen, E. Levänen and T. Mäntylä, In-flame deposits of Liquid Flame Spray generated silver, titania and silver-titania nanoparticles, International Congress on Particle Technology, Nuremberg, Germany, March 2007.
25. Nikkanen, J. P., H. Keskinen, M. Aromaa, J. M. Mäkelä, and T. Mäntylä Composite alumina-zirconia nanoparticles made by Liquid Flame Spray (LFS), Nanotech Northern Europe, Helsinki, Finland, March 2007.
26. Keskinen, H., J. M. Mäkelä, M. Aromaa, J. Keskinen, S. Areva, C. V. Teixeira, J. B. Rosenholm, V. Pore, M. Ritala, M. Leskelä, M. Raulio, M. S. Salkinoja-Salonen, E. Levänen and T. Mäntylä, Liquid Flame Spray made Titania and Titania-Silver Nanoparticle deposits Functionality as Photocatalyst for Organic- and Biofilm Removal, Nanotech Northern Europe, Helsinki, Finland March 2007.
27. Mäkelä, J. M., H. Keskinen, M. Aromaa, L. Hupa, M. Piispanen, K. Deppert, S. Persson, M. Lang, G. Gunnarsson, J. Pimenoff, T. Kronberg, V. Pore, M. Ritala, M. Leskelä, M. Raulio, M. S. Salkinoja-Salonen and V.-M. Airaksinen, A Nordic project on enhanced functionality of self-cleaning and antibacterial ceramic-metal surface coatings (FUNCOAT), Nanotech Northern Europe, Helsinki, Finland, March 2007.
28. Mäkelä, J. M.; H. Keskinen, M. Aromaa, L. Hupa, M. Piispanen, K. Deppert, S. Persson, M. Lang, G. Gunnarsson, J. Pimenoff, T. Kronberg, V. Pore, M. Ritala, M. Leskelä, M. Raulio, M. S. Salkinoja-Salonen and V.-M. Airaksinen. A Nordic Project on Enhanced Functionality of Self-Cleaning and Antibacterial Surface Coatings (FUNCOAT), 10th International Conference and Exhibition of the European Ceramic Society, Berlin, Germany, June 2007.
29. Aromaa, M., Keskinen, H., Mäkelä, J.M., Piispanen, M., Hupa, L., Deppert, K., Persson, S., Lang, M., Sandberg, P., Gunnarsson, G., Pimenoff, J., Kronberg, T., Pore, V., Ritala, M., Leskelä, M., Raulio, M., Salkinoja-Salonen, M.S. & Airaksinen, V.M., Characterisation of industrial aerosol nanoparticle generation process, EAC European Aerosol Conference 2007, Salzburg, Austria, September 2007.
30. Keskinen, H., Mäkelä, J.M., Aromaa, M., Heine, M.C. & Pratsinis, S.E., Droplet size characterization in spray flames, EAC European Aerosol Conference 2007, Salzburg, Austria, September 2007.
31. Mäkelä, J.M., Keskinen, H., Aromaa, M., Sainiemi, L., Luosujärvi, L., Kotiaho, T & Franssila, S., Fabrication of nanopillars for chemical analysis using deposited silica aerosol particles as etching mask, EAC European Aerosol Conference 2007, Salzburg, Austria, September 2007.
32. Aromaa, M., Mäkelä, J.M., Keskinen, H., Piispanen, M., Hupa, L., Deppert, K., Wagner, J.B., Wallenberg, L.R., Persson, S., Lang, M., Sundberg, P., Pimenoff, J., Kronberg, T., Pore, V., Heikkilä, M., Ritala, M., Leskelä, M., Raulio, M., Salkinoja-Salonen, M. & Airaksinen, V.-M., Optimization of industrial aerosol nanoparticle generation process for creating photocatalytic and anti-microbial surfaces, 2007 AIChE Annual Meeting, Salt Lake City, Utah, November 2007.
33. Aromaa, M., Keskinen, H., Mäkelä, J.M. & Pimenoff, J.A., Thin nanoparticle coating generated by Liquid Flame Spray method, E-MRS 2007 Fall Meeting, Warsaw, Poland, September 2007.
34. Mäkelä, J.M., Keskinen, H., Aromaa, M. & Pimenoff, J., Liquid flame spray method to generate thin nanoparticle coating, Development of Nanotechnologies and Nanomaterials,, Russian-Finnish Scientific Conference, Helsinki, Finland, September 2007.
35. Nikkanen, J-P., Keskinen, H., Aromaa, M., Järn, M., Kanerva, T., Levänen, E., Mäkelä, J.M., & Mäntylä, T., Composite alumina-zirconia nanoparticle synthesis by Liquid Flame Spray (LFS) from metal organic precursors, Sixteenth European Conference on Chemical Vapor Deposition, Schveningen, Den Haag, The Netherlands, September 2007.
36. Aromaa, M., Teini, S., Keskinen, H. & Mäkelä, J.M., Aerosol production of functional nanomaterial coatings, Physics, chemistry, biology and meteorology of atmospheric composition and climate change, Hyytiälä, Finland, April 2008.
37. Keskinen, H., Tricoli A., Marjamäki M., Mäkelä J., M. and S. E. Pratsinis, Size selected agglomerates as ultra sensitive gas sensors, EAC European Aerosol Conference 2009, Karlsruhe, Germany, September 2009.