Universidad Politécnica
de Madrid

Escuela Técnica Superior de Ingenieros Informáticos

Grado en Ingeniería Informática

Trabajo Fin de Grado

Diseño y Desarrollo de un Prototipo de Simulación para Robots Aéreos basado en Unreal 5, ROS2 y Gazebo (Informe Intermedio)

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Resumen

Aquí va el resumen del TFG. Extensión máxima 2 páginas.

Agradecimientos

Gracias

Índice general

1. Introducción

1.1. Descripción General

La simulación de drones es un campo relativamente nuevo, sin embargo, eso no implica que sea poco extenso. En los recientes años se han eralizado grandes avances e investigaciones con diversos fines. Desde el estudio de sus fisicas para su posterior implementación en entonrnos virtuales para su simulación, como estudios para descubrir los posibles usos que se les puede dar a estas versátiles máquinas, como puede ser su uso en seguridad de edificios, mantenimiento de campos de placas solares e incluso entretenimiento con enjambres de cientos de estos pequeños robots.

Asi pues, este trabajo tiene como objetivo crear un simulador de vuelo de drones en el entorno gráfico de Unreal Engine 5 realizando una integración con la librería de comunicación de C ROS2 para así crear un sistema de manejo automático de la trayectoría del dron. La implementación de la gran mayoría del proyecto se realizará en C++.

1.2. Unreal Engine 5

Como he mencionado previamente, el simulador se va a desarrollar para el motor de juego Unreal Engine 5 (UE5) desarrollado por la compañía Epic Games. Esta herramienta es muy reciente y cuenta con unos avances gráficos enormes, puediendo llegar a generar entornos que luven casi idénticos a los reales dando la impresión d eser grabaciones reales y no simulaciones generadas por ordenador. Asimismo cuenta con un sistema de físicas y colisiones integrado, lo que fácilitará las tareas de implementación más adelante. Como añadido, este entorno también cuenta con herramientas de Inteligencia Artifical, que se pueden usar para que controlen los actores que podamos llegar a tener en la escena.

El principal motivo para realizar el desarrollo en este motor, es con vistas a futuro, gracias a la gran capacidad gráfica que proporciona y la oportunidad de hacer uso de IA, hacer el entrenamiento de los drones dentro del simulador para luego poder transferirlo a máquinas reales y así no arriesgarse a dañar los reales.

2. Title of next chapter

2.1. Overview

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2.2. The next section

La insertación de código fuente se puede hacer directamente desde el archivo[1]:

Listing 2.1: Un programa en C

```c

int main() {
  char saludo[128] = "Hola mundo";
  printf("1: %s\n", saludo);
}
```

O con insertando un flotante de tipo Algoritmo y luego insertando igual que antes el archivo fuente:

Algoritmo 2.1 Una clase de Java

```java

public class UnaClase {

  private static final SALUDO = "Hola Mundo";

  public UnaClase() {
    System.out.println(SALUDO);
  }

  public static void main(String[] args) {
    new UnaClase();
  }

}
```

[1] Para insertar, hay que ir al menú insertar -> Archivo -> Documento hijo y seleccionar tipo de inclusión Listado de código fuente.

Se puede hacer referencia al flotante: Algoritmo 2.1 o a la referencia del listado: Listing 2.1.

Y se puede delimitar lo que se muestra utilizando las opciones del paquete *Listing*, mediante *firstline* y *lastline*, usando estas opciones en el recuadro de configuración.

Nota:
Como se puede ver si se introduce el título al insertar el documento hijo aparece *Listing*, se recomienda utilizar un flotante de tipo “Algoritmo” para mostrar código fuente.

3. Title of next chapter

3.1. Overview

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3.2. The next section

4. Title of next chapter

4.1. Overview

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4.2. The next section

A. Title of the first appendix chapter

A.1. Overview

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Bibliografía

[A+06] P. Abgrall et al. A novel fabrication method of flexible and monolithic 3D microfluidic structures using lamination of SU-8 films. *J. Micromech. Microeng.*, 16: 113–121, 2006, http://dx.doi.org/10.1088/0960-1317/16/1/016.

[ADK+03] Yu.S. Akishev, A.V. Dem'yanov, V.B. Karal'nik, A.E. Monich, and N.I. Trushkin. Comparison of the ac barrier corona with dc positive and negative coronas and barrier discharge. *Plasma Physics Reports*, 29: 90–100, 2003, http://www.triniti.ru/CTF&VM/Articles/Demyanov3.pdf.

[AG07] P. Abgrall and A.-M. Gué. Lab-on-chip technologies: making a microfluidic network and coupling it into a complete microsystem—a review. *J. Micromech. Microeng.*, 17: R15–R49, 2007, http://dx.doi.org/10.1088/0960-1317/17/5/R01.

[AST] ASTM e 1294-89 (1999), standard test method for pore size characteristics of membrane filters using automated liquid porosimeter, ASTM International. http://www.astm.org/DATABASE.CART/WITHDRAWN/E1294.htm.

[AST05] S.N. Abolmasov, T. Shirafuji, and K. Tachibana. Submillimeter dielectric barrier discharges at atmospheric pressure: Edge effect. *IEEE Trans. Plasma Sci.*, 33: 941–948, 2005, http://dx.doi.org/10.1109/TPS.2005.845093.

[B+01a] S.E. Babayan et al. Deposition of silicon dioxide films with a non-equilibrium atmospheric-pressure plasma jet. *Plasma Sources Sci. Technol.*, 10(4): 573–578, 2001, http://dx.doi.org/10.1088/0963-0252/10/4/305.

[B+01b] N.A. Bullett et al. Direct imaging of plasma-polymerized chemical micropatterns. *Surf. Interface Anal.*, 31(11): 1074–1076, 2001, http://dx.doi.org/10.1002/sia.1146.

[B+04] F. J. Blanco et al. Novel three-dimensional embedded SU-8 microchannels fabricated using a low temperature full wafer adhesive bonding. *J. Micromech. Microeng.*, 14: 1047–1056, 2004, http://dx.doi.org/10.1088/0960-1317/14/7/027.

[B+07] R. Brandenburg et al. Antimicrobial treatment of heat sensitive materials by means of atmospheric pressure Rf-

driven plasma jet. *Contrib. Plasma Phys.*, 47: 72 – 79, 2007, http://dx.doi.org/10.1002/ctpp.200710011.

[BCG09] M.C. Breadmore, E. Candish, and R.M. Guijt. Dry film photoresist, saving time and money without compromising on performance. In *μTAS 2009*, 2009.

[BNCK04] B. Bilenberg, T. Nielsen, B. Clausen, and A. Kristensen. Pmma to su-8 bonding for polymer based lab-on-a-chip systems with integrated optics. *J. Micromech. Microeng.*, 14: 814 – 818, 2004, http://dx.doi.org/10.1088/0960-1317/14/6/008.

[BNGvdM02] A. Bogaerts, E. Neyts, R. Gijbels, and J. van der Mullen. Gas discharge plasmas and their applications. *Spectrochim. Acta. B Atom. Spectros.*, 57(4): 609–658, 2002, http://dx.doi.org/10.1016/S0584-8547(01)00406-2.

[Boh89] Willi Bohl. *Technische Strömungslehre*. Vogel-Verlag, Würzburg, 8th edition, 1989.

[Bru08] Henrik Bruus. *Theoretical Microfluidics*. Oxford University Press, 2008.

[BSE06] K.H. Becker, K.H. Schoenbach, and J.G. Eden. Microplasmas and applications. *J. Phys. D: Appl. Phys.*, 39: R55 – R70, 2006, http://dx.doi.org/10.1088/0022-3727/39/3/R01.

[BWMK05] R. Brandenburg, H.-E. Wagner, A.M. Morozov, and K.V. Kozlov. Axial and radial development of microdischarges of barrier discharges in N2/O2 mixtures at atmospheric pressure. *J. Phys. D: Appl. Phys.*, 38(11): 1649 – 1657, 2005, http://dx.doi.org/10.1088/0022-3727/38/11/003.

[C$^+$04] J. Carlier et al. Integrated microfluidics based on multilayered su-8 for mass spectrometry analysis. *J. Micromech. Microeng.*, 14: 619 – 624, 2004, http://dx.doi.org/10.1088/0960-1317/14/4/024.

[Car03] W.R. Carr. On the laws governing electric discharges in gases at low pressures. *Phil. Trans. Roy. Soc. Lond. Math. Phys. Sci.*, 201: 403–433, 1903, http://dx.doi.org/10.1098/rsta.1903.0020.

[CBS67a] F.M. Charbonnier, C.J. Bennette, and L.W. Swanson. Electrical breakdown between metal electrodes in high vacuum. i. theory. *J. Appl. Phys.*, 38: 627 – 633, 1967, http://dx.doi.org/10.1063/1.1709385.

[CBS67b] F.M. Charbonnier, C.J. Bennette, and L.W. Swanson. Electrical breakdown between metal electrodes in high vacuum. ii. experimental. *J. Appl. Phys.*, 38: 634 – 640, 1967, http://dx.doi.org/10.1063/1.1709386.

[CGW77] DJ Carlsson, A. Garton, and DM Wiles. The weatherability of

polypropylene monofilaments. effects of fiber production conditions. *Journal of Applied Polymer Science*, 21(11): 2963–2978, 1977, http://dx.doi.org/10.1002/app.1977.070211112.

[CK00] H.-K. Chang and Y.-K. Kim. UV-LIGA process for high aspect ratio structure using stress barrier and C-shaped etch hole. *Sensors and Actuators A*, 84: 342–350, 2000, http://dx.doi.org/10.1016/S0924-4247(00)00408-8.

[CS96] J.J. Coogan and A.D. Sappey. Distribution of OH within silent discharge plasma reactors. *IEEE Trans. Plasma Sci.*, 24(1): 91–92, 1996, http://dx.doi.org/10.1109/27.491706.

[Cut93] P. Cutler. Theory of electron emission in high fields from atomically sharp emitters: Validity of the fowler-nordheim equation. *Progress in Surface Science*, 42(1-4): 169–185, 1993, http://dx.doi.org/10.1016/0079-6816(93)90068-7.

[D+04] A.J. Dikmans et al. A new compact disc format of high density array synthesis applied to peptide nucleic acids and in situ MALDI analysis. *Molecular diversity*, 8(3): 197–207, 2004, http://dx.doi.org/10.1023/B:MODI.0000036234.66238.4e.

[Dav98] J.R. Davis. *Metals handbook: desk edition*. ASM International, 2nd edition, 1998.

[DK03] R. Dorai and M.J. Kushner. A model for plasma modification of polypropylene using atmospheric pressure discharges. *J. Phys. D: Appl. Phys*, 36(6): 666–685, 2003, http://dx.doi.org/10.1088/0022-3727/36/6/309.

[Dor02] Rajesh Dorai. *Modeling of Atmospheric Pressure Plasma Processing of Gases and Surfaces*. PhD thesis, University of Illinois at Urbana-Champaign, 2002.

[Dus23] S. Dushman. Electron emission from metals as a function of temperature. *Physical Review*, 21: 623–636, 1923, http://dx.doi.org/10.1103/PhysRev.21.623.

[E+03] J.G. Eden et al. Microplasma devices fabricated in silicon, ceramic, and metal/polymer structures: arrays, emitters and photodetectors. *J. Phys. D: Appl. Phys.*, 36: 2869–2877, 2003, http://dx.doi.org/10.1088/0022-3727/36/23/001.

[EK91] B. Eliasson and U. Kogelschatz. Modeling and applications of silent discharge plasmas. *IEEE Trans. Plasma Sci.*, 19(2): 309–323, 1991, http://dx.doi.org/10.1109/27.106829.

[ETMK05] M. Eichler, M. Thomas, H. Mewes, and C.-P. Klages. Ortsselektive Atmosphärendruck-Plasmavorbehandlung für das Direkt-Wafer-Bonden bei niedrigen Temperaturen. In *Mikrosystemtechnik Kongress 2005 : 10. bis 12. Oktober 2005 in Freiburg.*

Berlin: VDE-Verlag, 2005, pp. 115-118, 2005, http://www.vde-verlag.de/data/buecher.php?action=bookdetail&vertriebsnr=562926.

[F+03] K.Saalwächter F.Kleinschmidt, U.Stöhr et al. Nmr spectroscopy characterization and self-diffusion study of partially swollen polymer networks. *Macromol. Chem. Phys.*, 204: F24 – F25, 2003.

[FCKS01] M. Fahland, C. Charton, V. Kirchhoff, and U. Stöhr. Deposition of multilayer optical coatings onto plastic webs by pulse magnetron sputtering; challenges and opportunities. In *Proceedings 6th. International Symposium on Sputtering and Plasma Processes (ISSP), p. 189, Kanazawa, Japan*, 2001.

[FN28] R.H. Fowler and L. Nordheim. Electron emission in intense electric fields. *Proceedings of the Royal Society of London. Series A, Containing Papers of a Mathematical and Physical Character*, 119(781): 173 – 181, May 1928, http://www.jstor.org/pss/95023.

[FNC02] W.W. Flack, H.A. Nguyen, and E. Capsuto. Characterization of a novel photoresist redistribution material for advanced packaging applications. In *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*, volume 4690, pages 1203 – 1216, 2002, http://dx.doi.org/10.1117/12.474198.

[For99] R.G. Forbes. Refining the application of fowler-nordheim theory. *Ultramicroscopy*, 79: 11 – 23, 1999, http://dx.doi.org/10.1016/S0304-3991(99)00097-2.

[G+] Yu. B. Golubovskii et al. Homogeneous barrier discharge. Internet: http://optics.phys.spbu.ru/~golub/english/barrier.html.

[GEB+08] I. Graz, A. Ebner, S. Bauer, C. Romanin, and H. Gruber. Micropatterned atmospheric pressure discharge surface modification of fluorinated polymer films for mammalian cell adhesion and protein binding. *Appl. Phys. A*, 92: 547 – 555, 2008, http://dx.doi.org/10.1007/s00339-008-4614-z.

[GEK] GEKA mbH. Destroying chemical warfare agents and contaminated military waste. Internet: http://www.geka-munster.de/Seiten-engl/vernichtung/plasma-index.html (accessed 06-09-2009).

[Ger03] M. Gerbracht. Trocknung dicker Photoresistschichten mittels unterschiedlicher Trocknungsverfahren. Diplomarbeit, Fachhochschule Düsseldorf, 2003.

[GMBB01] Yu.B. Golubovskii, V.A. Maiorov, J. Behnke, and J.F. Behnke. The role of emission from the dielectric surface in a homogeneous barrier discharge in nitrogen. In *Proc. of 15th Int. Symp. on Plasma Chemistry (Orléans, France, 10-13 July 2001) vol VIII p 3239-3244*, 2001, http://optics.phys.spbu.ru/ golub/articles/DBD_ISPC15.pdf.

[GMBB02] Yu. B. Golubovskii, V. A. Maiorov, J. Behnke, and J. F. Behnke. Some aspects of the modeling of an uniform barrier discharge in nitrogen. In *Proc. of 16th ESCAMPIG/5th ICRP (Grenoble, France, 14-18 July 2002), Vol. 1, p. 233-234*, 2002, http://optics.phys.spbu.ru/ golub/articles/DBD_N2_16ESCAMPIG.pdf.

[GMBB03] Yu.B. Golubovskii, V.A. Maiorov, J. Behnke, and J.F. Behnke. Modelling of the homogeneous barrier discharge in helium at atmospheric pressure. *J. Phys. D: Appl. Phys.*, 36: 39–49, 2003, http://dx.doi.org/10.1088/0022-3727/36/1/306.

[GMS98] A. Goossens, E.L. Maloney, and J Schoonman. Gas-phase synthesis of nanostructured anatase TiO_2. *Chemical Vapor Deposition*, 4(3): 109–114, 1998, http://dx.doi.org/10.1002/(SICI)1521-3862(199805)04:03<109::AID-CVDE109>3.0.CO;2-U.

[Gol] Yu. B. Golubovskii. Internet: http://optics.phys.spbu.ru/~golub/images/filament.jpg (accessed 07-09-2009).

[GU93] S.R. Gaboury and M.W. Urban. Microwave plasma reactions of solid monomers with silicone elastomer surfaces: a spectroscopic study. *Langmuir*, 9(11): 3225–3233, 1993, http://dx.doi.org/10.1021/la00035a076.

[GvJBB02] Yu.B. Golubovskii, V.A. Maiorov v J. Behnke, and J.F. Behnke. Stability of the barrier discharge relative to the filamentation. In *Proc. of 16th ESCAMPIG/5th ICRP (Grenoble, France, 14-18 July 2002), Vol. 1, p. 235-236*, 2002, http://optics.phys.spbu.ru/ golub/articles/barrier2d_16ESCAMPIG.pdf.

[H+07] K. Hensel et al. Electrical and optical properties of AC microdischarges in porous ceramics. *Plasma Process. Polym.*, 4: 682–693, 2007, http://dx.doi.org/10.1002/ppap.200700022.

[HBMB00] K. Handique, D.T. Burke, C.H. Mastrangelo, and M.A. Burns. Nanoliter liquid metering in microchannels using hydrophobic patterns. *Anal. Chem.*, 72(17): 4100–4109, 2000, http://dx.doi.org/10.1021/ac000064s.

[HGB+98] M.O. Heuschkel, L. Guérin, B. Buisson, D. Bertrand, and P. Renaud. Buried microchannels in photopolymer for delivering of solutions to neurons in a network. *Sensors and Actuators B*, 48: 356–361, 1998, http://dx.doi.org/10.1016/S0925-4005(98)00071-9.

[HLLL03] M. Han, W. Lee, S.-K. Lee, and S.S. Lee. 3D microfabrication with inclined/rotated UV lithography. *Sensors and Actuators A*, 111: 14–20, 2003, http://dx.doi.org/10.1016/j.sna.2003.10.006.

[HNF+04] M. Heise, W. Neff, O. Franken, P. Muranyi, and J. Wunderlich. Sterilization of polymer foils with dielectric barrier dischar-

ges at atmospheric pressure. *Plasmas polym.*, 9: 23 – 33, 2004, http://dx.doi.org/10.1023/B:PAPO.0000039814.70172.c0.

[HNRA04] K.H. Ho, S.T. Newman, S. Rahimifard, and R.D. Allen. State of the art in wire electrical discharge machining (WEDM). *Int. J. Mach. Tool. Manufact.*, 44(12 - 13): 1247 – 1259, 2004, http://dx.doi.org/10.1016/j.ijmachtools.2004.04.017.

[HSG03] M. Heule, U.P. Schönholzer, and L.J. Gauckler. Patterning colloidal suspensions by selective wetting of microcontact-printed surfaces. *J. Eur. Ceram. Soc.*, 24: 2733 – 2739, 2003, http://dx.doi.org/10.1016/j.jeurceramsoc.2003.09.011.

[I+07] T. Ito et al. Characterization of a microfluidic device fabricated using a photosensitive sheet. *J. Micromech. Microeng.*, 17: 432 – 438, 2007, http://dx.doi.org/10.1088/0960-1317/17/3/003.

[ISOa] ISO 10780:1994, stationary source emissions – measurement of velocity and volume flowrate of gas streams in ducts, ISO. http://www.iso.org/iso/catalogue_detail.htm?csnumber=18855.

[ISOb] ISO 4003:1977, permeable sintered metal materials – determination of bubble test pore size, ISO. http://www.iso.org/iso/catalogue_detail.htm?csnumber=9678.

[ISOc] ISO 4287 (1997), geometrical product specifications surface texture profile method terms, definitions and surface texture parameters, ISO. http://www.iso.org/iso/catalogue_detail.htm?csnumber=10132.

[ITM98] N. Inagaki, S. Tasaka, and M. Makino. Plasma polymer deposition from mixture of tetramethoxysilane and oxygen on PET films and their oxygen gas barrier properties. *J. Appl. Polym. Sci.*, 64(6): 1031 – 1039, 1998, http://dx.doi.org/10.1002/%28SICI%291097-4628%2819970509%2964%3A6%3C1031%3A%3AAID-APP1%3E3.0.CO%3B2-M.

[Jen02] K.L. Jensen. Theory of field emission. *Vacuum Microelectronics*, Chapter 3: 33 – 104, 2002, http://dx.doi.org/10.1002/0471224332.ch3.

[Jen03] K.L. Jensen. Electron emission theory and its application: Fowler–nordheim equation and beyond. *J. Vac. Sci. Technol. B*, 21(4): 1528 – 1544, 2003, http://dx.doi.org/10.1116/1.1573664.

[JFG+01] R.J. Jackman, T.M. Floyd, R. Ghodssi, M.A. Schmidt, and K.F. Jensen. Microfluidic systems with on-line uv detection fabricated in photodefinable epoxy. *J. Micromech. Microeng.*, 11: 1 – 8, 2001, http://dx.doi.org/10.1088/0960-1317/11/3/316.

[JJM+06] S. Jigueta, M. Judelewicza, S. Mischlerb, A. Bertchc, and P. Renaudc. Effect of filler behavior on nanocomposite SU8 photoresist

for moving micro-parts. *Microelectron. Eng.*, 83: 1273 – 1276, 2006, http://dx.doi.org/10.1016/j.mee.2006.01.068.

[JPB06] N. Jidenko, M. Petit, and J.P. Borra. Electrical characterization of microdischarges produced by dielectric barrier discharge in dry air at atmospheric pressure. *J. Phys. D: Appl. Phys.*, 39(2): 281 – 293, 2006, http://dx.doi.org/10.1088/0022-3727/39/2/008.

[K+03] M.G. Kwak et al. Improvement of luminance efficiency in xenon dielectric barrier discharge flat lamp. *IEEE Trans. Plasma Sci.*, 31: 176 – 178, 2003, http://dx.doi.org/10.1109/TPS.2003.808867.

[K+04] K. Kim et al. A tapered hollow metallic microneedle array using backside exposure of SU-8. *J. Micromech. Microeng.*, 14: 597 – 603, 2004, http://dx.doi.org/10.1088/0960-1317/14/4/021.

[K+05] K.V. Kozlov et al. Barrier discharges in N2/O2 mixtures. *J. Phys. D: Appl. Phys.*, 38: 518 – 529, 2005, http://dx.doi.org/10.1088/0022-3727/38/4/003.

[K+07] C.P. Klages et al. Surface technology with cold microplasmas. *Plasma Process. Polym.*, 4(3): 208 – 218, 2007, http://dx.doi.org/10.1002/ppap.200600116.

[KBET07] C.P. Klages, C. Berger, M. Eichler, and M. Thomas. Microplasma-based treatment of inner surfaces in microfluidic devices. *Contributions to Plasma Physics*, 47: 49 – 56, 2007, http://dx.doi.org/10.1002/ctpp.200710008.

[KE05] S.-O. Kim and J.G. Eden. Arrays of microplasma devices fabricated in photodefinable glass and excited AC or DC by interdigitated electrodes. *IEEE Photonics Technology Letters*, 17: 1543 – 1545, 2005, http://dx.doi.org/10.1109/LPT.2005.848260.

[KFG+03] E. Kukharenka, M.M. Farooqui, L. Grigore, M. Kraft, and N. Hollinshead. Electroplating moulds using dry film thick negative photoresist. *J. Micromech. Microeng.*, 13: S67 – S74, 2003, http://dx.doi.org/10.1088/0960-1317/13/4/311.

[KFK07] T. Koida, H. Fujiwara, and M. Kondo. Hydrogen-doped In_2O_3 as high-mobility transparent conductive oxide. *Jpn. J. Appl. Phys.*, 46(28): L685 – L687, 2007, http://dx.doi.org/10.1143/JJAP.46.L685.

[KHKT00] C.P. Klages, K. Höpfner, N. Kläke, and R. Thyen. Surface functionalization at atmospheric pressure by DBD-based pulsed plasma polymerization. *Plasmas and Polymers*, 5(2): 79 – 89, 2000, http://dx.doi.org/10.1023/A:1009583815474.

[KJI+04] J. Kieninger, G. Jobst, G. Igel, I. Moser, and G. Urban. 3D polymer microstructures by laminating SU-8 films. In *Proceedings of μTAS 2004*, volume 2, pages 363 – 365, 2004.

[KK08] Y.K. Kim and D. J. Kim. Deposition of super hydrophobic a-C:F films by dielectric barrier discharge at atmospheric pressure. In *Book of Abstract of 11th International Conference on Plasma Surface Engineering PSE 2008*, 2008, http://www.pse2008.net/pdf_edit/tmp/PO1063-PSE2008-2f1418.pdf.

[Kog02] U. Kogelschatz. Filamentary, patterned, and diffuse barrier discharges. *IEEE Trans. Plasma Sci.*, 30(4): 1400 – 1408, 2002, http://dx.doi.org/10.1109/TPS.2002.804201.

[Kog03] U. Kogelschatz. Dielectric-barrier discharges: Their history, discharge physics, and industrial applications. *Plasma Chem. Plasma Process.*, 23: 1 – 46, 2003, http://dx.doi.org/10.1023/A:1022470901385.

[KPKH03] W.S. Kang, J.M. Park, Y. Kim, and S.H. Hong. Numerical study on influences of barrier arrangements on dielectric barrier discharge characteristics. *IEEE Trans. Plasma Sci.*, 31(4): 504 – 510, 2003, http://dx.doi.org/10.1109/TPS.2003.815469.

[KPTK05] S. Kreitz, C. Penache, M. Thomas, and C.-P. Klages. Patterned DBD treatment for area-selective metallization of polymers-plasma printing. *Surf. Coat. Technol.*, 200: 676 – 679, 2005, http://dx.doi.org/10.1016/j.surfcoat.2005.01.085.

[KTMI69] H. Kawauchi, K. Tuzimura, H. Maeda, and N. Ishida. Reaction of fluorescein-isothiocyanate with proteins and amino acids: II. preparation of fiuorescein-thiohydantoin amino acids and their thin-layer chromatography. *Journal of Biochemistry*, 66(6): 783 – 789, 1969, http://jb.oxfordjournals.org/cgi/content/abstract/66/6/783.

[Kun00] E.E. Kunhardt. Generation of large-volume, atmospheric-pressure, nonequilibrium plasmas. *IEEE Trans. Plasma Sci.*, 28: 189 – 200, 2000, http://dx.doi.org/10.1109/27.842901.

[LEKB08] N. Lucas, V. Ermel, M. Kurrat, and S. Büttgenbach. Microplasma stamps for selective surface modification: design and characterization. *J. Phys. D: Appl. Phys.*, 41: 215202 (7pp), 2008, http://dx.doi.org/10.1088/0022-3727/41/21/215202.

[Lev44] K. Levenberg. A method for the solution of certain non-linear problems in least squares. *Q. Appl. Math*, 2(2): 164 – 168, 1944.

[LHKB08] N. Lucas, A. Hinze, C.-P. Klages, and S. Büttgenbach. Design and optimization of dielectric barrier discharge microplasma stamps. *J. Phys. D: Appl. Phys.*, 41: 194012 (5pp), 2008, http://dx.doi.org/10.1088/0022-3727/41/19/194012.

[Lid07] David R. Lide, editor. *CRC Handbook of Chemistry and Physics*. Taylor and Francis, 87th edition, 2007.

[LOUY] L. Ledernez, F. Olcaytug, G. Urban, and H. Yasuda. Influence of the electrode material on the electrical breakdown of argon. accepted for Plasma Sources Science and Technology.

[LPCE07] M. Lu, S.-J. Park, B.T. Cunningham, and J.G. Eden. Microcavity plasma devices and arrays fabricated by plastic-based replica molding. *J. Microelectromech. Syst.*, 16: 1397 – 1402, 2007, http://dx.doi.org/10.1109/JMEMS.2006.886034.

[LPCE08] M. Lu, S.-J. Park, B.T. Cunningham, and J.G. Eden. Low temperature plasma channels generated in microcavity trenches with widths of 20 - 150 µm and aspect ratios as large as $10^4 : 1$. *Appl. Phys. Lett.*, 92: 1397 – 1402, 2008, http://dx.doi.org/10.1063/1.2827197.

[LU05] B.A. Langowski and K.E. Uhrich. Microscale plasma-initiated patterning (µPIP). *Langmuir*, 21: 10509 – 10514, 2005, http://dx.doi.org/10.1021/la052222m.

[Luc09] N. Lucas. *Microplasma Stamps - An Atmospheric-Pressure Plasma Source for the Area-Selective Modification of Surfaces*. PhD thesis, Institute for Microtechnology, TU Braunschweig, 2009.

[M+00] S.F. Miralaï et al. Electrical and optical diagnostics of dielectric barrier discharges (DBD) in He and N2 for polymer treatment. *Plasmas and Polymers*, 5(2): 63 – 77, 2000, http://dx.doi.org/10.1023/A:1009531831404.

[M+01] F. Massines et al. The role of dielectric barrier discharge atmosphere and physics on polypropylene surface treatment. *Plasmas and Polymers*, 6(1): 35 – 49, 2001, http://dx.doi.org/10.1023/A:1011365306501.

[M+06] K. Misumi et al. Faster sensitivity and non-antimonite permanent photoresist for MEMS. In Qinghuang Lin, editor, *Advances in Resist Technology and Processing XXIII*, volume 6153 of *Proceedings of SPIE*, page 61534F. SPIE, 2006, http://dx.doi.org/10.1117/12.656249.

[M+08] G.S. Malkov et al. Pulsed-plasma-induced micropatterning with alternating hydrophilic and hydrophobic surface chemistries. *Plasma Process. Polym.*, 5(2): 129 – 145, 2008, http://dx.doi.org/10.1002/ppap.200700118.

[MA88] W.M. Mullins and B.L. Averbach. Surface properties of silicon and aluminum oxide powders. *Surface Science*, 206(1-2): 41 – 51, 1988, http://dx.doi.org/10.1016/0039-6028(88)90013-1.

[MA04] C.R. Martin and I.A. Aksay. Submicrometer-scale patterning of ceramic thin films. *J. of Electroceramics*, 12(1): 53 – 68, 2004, http://dx.doi.org/10.1023/B:JECR.0000034001.15359.98.

[Mar63] Donald W. Marquardt. An algorithm for least-squares estimation of nonlinear parameters. *SIAM Journal on Applied Mathematics*, 11(2): 431 – 441, 1963, http://dx.doi.org/10.1137%2F0111030.

[MFR06] A. Mata, A.J. Fleischmann, and S. Roy. Fabrication of multilayer SU-8 microstructures. *J. Micromech. Microeng.*, 16: 276 – 284, 2006, http://dx.doi.org/10.1088/0960-1317/16/2/012.

[MFSM02] W. Menz, R. Förster, A. Schoth, and C. Müller. Non-conventional machining for microsystems. In *Proc. 3rd Euspen Int. Conf.*, page 37, 2002.

[MG56] E.L. Murphy and R.H. Good, Jr. Thermionic emission, field emission, and the transition region. *Phys. Rev.*, 102: 1464 – 1473, 1956, http://dx.doi.org/10.1103/PhysRev.102.1464.

[MPA+99] I. Müller, C. Punset, E. Ammelt, H.-G. Purwins, and J.P. Boeuf. Self-organized filaments in dielectric barrier glow discharges. *IEEE Trans. Plasma Sci.*, 27: 20 – 21, 1999, http://dx.doi.org/10.1109/27.763004.

[MPGJ97] C. Martinet, V. Paillard, A. Gagnaire, and J. Joseph. Deposition of SiO_2 and TiO_2 thin films by plasma enhanced chemical vapor deposition for antireflection coating. *J. Non-Cryst. Solids*, 216: 77 – 82, 1997, http://dx.doi.org/10.1016/S0022-3093(97)00175-0.

[MSTH96] K.A. Melzak, C.S. Sherwood, R.F.B. Turner, and C.A. Haynes. Driving forces for DNA adsorption to silica in perchlorate solutions. *J. Colloid Interface Sci.*, 181(2): 635 – 644, 1996, http://dx.doi.org/10.1006/jcis.1996.0421.

[MSY+06] K. Misumi, K. Saito, A. Yamanouchi, T. Senzaki, and H. Honma. Minute tunnel structure formation with permanent film photoresist. *J. Photopolym. Sci. Technol.*, 19: 57 – 62, 2006, http://dx.doi.org/10.2494/photopolymer.19.57.

[MT98] T. Masuzawa and T. Takawashi. Recent trends in EDM/ECM technologies in Japan. *VDI BERICHTE*, 1405: 1 – 16, 1998.

[NDSL04] M. Noeske, J. Degenhardt, S. Strudthoff, and U. Lommatzsch. Plasma jet treatment of five polymers at atmospheric pressure: surface modifications and the relevance for adhesion. *International Journal of Adhesion & Adhesives*, 24: 171 – 177, 2004, http://dx.doi.org/10.1016/j.ijadhadh.2003.09.006.

[NHKV09] D. Nußbaum, D. Herrmann, T. Knoll, and T. Velten. Micromixing structures for lab-on chip applications: Fabrication and simulation of 90° zigzag microchann els in dry film resist. In *4M / ICOMM 2009 Conference*, pages 215 – 218, 2009, http://dx.doi.org/10.1243/17547164C0012009041.

[NHW01] A. Nakajima, K. Hashimoto, and T. Watanabe. Recent studies on super-hydrophobic films. *Monatshef-*

te für Chemie / Chemical Monthly, 132: 31–41, 2001, http://dx.doi.org/10.1007/s007060170142.

[Nie95] L. Niemeyer. A generalized approach to partial discharge modeling. *IEEE Transactions on Dielectrics and Electrical Insulation*, 2(4): 510–528, 1995, http://dx.doi.org/10.1109/94.407017.

[Nor28] L. Nordheim. Zur theorie der thermischen emission und der reflexion von elektronen an metallen. *Zeitschrift für Physik A Hadrons and Nuclei*, 46(11 - 12): 833–855, November 1928, http://dx.doi.org/10.1007/BF01391020.

[O'B01] J. O'Brien. Advanced photoresist technologies for microsystems. *J. Micromech. Microeng.*, 11: 353–358, 2001, http://dx.doi.org/10.1088/0960-1317/11/4/312.

[Ols98] Anders Olsson. *Valve-less Diffuser Micropumps*. PhD thesis, School of Electrical Engineering, Royal Institute of Technology, Stockholm, Sweden, 1998.

[OS99] A. Ohl and K. Schröder. Plasma-induced chemical micropatterning for cell culturing applications: a brief review. *Surf. Coat. Technol.*, 116: 820–830, 1999, http://dx.doi.org/10.1016/S0257-8972(99)00150-4.

[Pas89] F. Paschen. Ueber die zum Funkenübergang in Luft, Wasserstoff und Kohlensäure bei verschiedenen Drucken erforderliche Potentialdifferenz. *Annalen der Physik*, 273(5): 69–96, 1889, http://dx.doi.org/10.1002/andp.18892730505.

[PCI] PCI-SIG. PCI conventional specifications. Internet: http://www.pcisig.com/specifications/conventional (accessed 08-01-2010).

[PGB+04] C. Penache, C. Gessner, T. Betker, V. Bartels, and C.-P. Klages. Plasma printing: patterned surface functionalisation and coating at atmospheric pressure. *IEE Proc.-Nanobiotechnol.*, 151: 139–144, 2004, http://dx.doi.org/10.1049/ip-nbt:20040836.

[PHHS01] J. Park, I. Henins, H.W. Herrmann, and G.S. Selwyn. Discharge phenomena of an atmospheric pressure radio-frequency capacitive plasma source. *J. Appl. Phys.*, 89: 20–28, 2001, http://dx.doi.org/10.1063/1.1323753.

[PJF02] W.G. Payne, B.W. James, and I.S. Falconer. The growth and decay of miniature dielectric barrier discharges in helium, neon, and argon. *IEEE Trans. Plasma Sci.*, 30: 170–171, 2002, http://dx.doi.org/10.1109/TPS.2002.1003978.

[PKE05] S.-J. Park, K.S. Kim, and J.G. Eden. Nanoporous alumina as a dielectric for microcavity plasma devices: Multilayer Al/AlO structures. *Appl. Phys. Lett.*, 86: 221501, 2005, http://dx.doi.org/10.1063/1.1923747.

[PP99] A.V. Phelps and Z.Lj. Petrovic. Cold-cathode discharges and breakdown in argon: surface and gas phase production of secondary electrons. *Plasma Sources Sci. Technol.*, 8: 21–44, 1999, http://dx.doi.org/10.1088/0963-0252/8/3/201.

[PYS+02] C.-T. Pan, H. Yang, S.-C. Shen, M.-C. Chou, and H.-P. Chou. A low-temperature wafer bonding technique using patternable materials. *J. Micromech. Microeng.*, 12: 611–615, 2002, http://dx.doi.org/10.1088/0960-1317/12/5/315.

[RBCW03] I. Radu, R. Bartnikas, G. Czeremuszkin, and M.R. Wertheimer. Diagnostics of dielectric barrier discharges in noble gases: Atmospheric pressure glow and pseudoglow discharges and spatio-temporal patterns. *IEEE Trans. Plasma Sci.*, 31(3): 411–421, 2003, http://dx.doi.org/10.1109/TPS.2003.811647.

[RBW05] I. Radu, R. Bartnikas, and M.R. Wertheimer. Diagnostics and modelling of noble gas atmospheric pressure dielectric barrier discharges in homogeneous or diverging electric fields. *J. Phys. D: Appl. Phys.*, 38: 539–546, 2005, http://dx.doi.org/10.1088/0022-3727/38/4/005.

[RCJ+07] A.D. Radadia, L. Cao, H.-K. Jeong, M.A. Shannon, and R.I. Masel. A 3D micromoxer fabricated with dry film resist. In *Proc. of MEMS 2007*, pages 361–364, 2007, http://dx.doi.org/10.1109/MEMSYS.2007.4433110.

[Ric21] O.W. Richardson. *The Emission of Electricity from Hot Bodies*. Longmans, Green and co., 1921.

[RKML05] R.B. Rao, K.L. Krafcik, A.M. Morales, and J. Lewis. Microfabricated deposition nozzles for direct-write assembly of three-dimensional periodic structures. *Adv. Mater.*, 17(3): 289–293, 2005, http://dx.doi.org/10.1002/adma.200400514.

[RRPR07] M. Radmilovic-Radjenovic, Z.L. Petrovic, and B. Radjenovic. Modelling of breakdown behavior by PIC/MCC code with improved secondary emission models. *J. Phys.: Conf. Ser.*, 71(1): 012007, 2007, http://dx.doi.org/10.1088/1742-6596/71/1/012007.

[S+00] R.C. Smith et al. Chemical vapour deposition of the oxides of titanium, zirconium and hafnium for use as high-k materials in microelectronic devices. a carbon-free precursor for the synthesis of hafnium dioxide. *Adv. Mater. Opt. and Electron.*, 10(3-5): 105–114, 2000, http://dx.doi.org/10.1002/1099-0712(200005/10)10:3/5<105::AID-AMO402>3.0.CO;2-J.

[S+07a] A. Schenk et al. Microstructured electrode arrays: Optical analysis of the glow discharge in a magnified electrode gap. *Plasma Process. Polym.*, 4: S927–S930, 2007, http://dx.doi.org/10.1002/ppap.200732301.

[S+07b] K. Stephan et al. Fast prototyping using a dry film photoresist: microfabrication of soft-lithography masters for microfluidic structures. *J. Micromech. Microeng.*, 17: N69–N74, 2007, http://dx.doi.org/10.1088/0960-1317/17/10/N01.

[S+09] Uwe Stöhr et al. Multilayer photoresist stamps for selective plasma treatment in micrometer scales. *Plasma Process. Polym.*, 6(4): 228–233, 2009, http://dx.doi.org/10.1002/ppap.200800217.

[S+10] U. Stöhr et al. Porous photoresist stamps for selective plasma treatment. *Plasma Processes Polym.*, 7(1): 9–15, 2010, http://dx.doi.org/10.1002/ppap.200900063.

[SBL07] O. Stalter, B. Burger, and S. Lehrmann. Silicon Carbide (SiC) D-MOS for grid-feeding solar-inverters. In *European Conference on Power Electronics and Applications, 2007*, pages 1–10, 2007, http://dx.doi.org/10.1109/EPE.2007.4417654.

[SBTML06] C. Sarra-Bournet, S. Turgeon, D. Mantovani, and G. Laroche. A study of atmospheric pressure plasma discharges for surface functionalization of PTFE used in biomedical applications. *J. Phys. D: Appl. Phys.*, 39(16): 3461–3469, 2006, http://dx.doi.org/10.1088/0022-3727/39/16/S03.

[SC07] J.W. Suk and J. Cho. Capillary flow control using hydrophobic patterns. *J. Micromech. Microeng.*, 17(4): N11–N15, 2007, http://dx.doi.org/10.1088/0960-1317/17/4/N01.

[SG99] U.P Schönholzer and L.J. Gauckler. Ceramic parts patterned in the micrometer range. *Adv. Mater.*, 11(8): 630–632, 1999, http://www.cheric.org/research/tech/periodicals/doi.php?art_seq=646499.

[SMS04] K.H. Schoenbach, M. Moselhy, and W. Shi. Self-organization in cathode boundary layer microdischarges. *Plasma Sources Sci. Technol.*, 13(1): 177–185, 2004, http://dx.doi.org/10.1088/0963-0252/13/1/023.

[Soc94] G. Socrates. *Infrared and Raman characteristic group frequencies: tables and charts*. John Wiley & Sons, 2nd edition, 1994.

[SOK95] Y. Sawada, S. Ogawa, and M. Kogoma. Synthesis of plasma-polymerized tetraethoxysilane and hexamethyldisiloxane films prepared by atmospheric pressure glow discharge. *J. Phys. D: Appl. Phys.*, 28: 1661–1661, 1995, http://dx.doi.org/10.1088/0022-3727/28/8/015.

[Sou] J. R. Southern. Toronto thunderstorm. Internet: http://en.wikipedia.org/wiki/File:Krunkwerke_-_IMG_4515_%28by-sa%29.jpg (accessed 07-09-2009).

[Sta06] S.M. Starikovskaia. Plasma assisted ignition and combus-

tion. *J. Phys. D: Appl. Phys.*, 39(16): R265–R299, 2006, http://dx.doi.org/10.1088/0022-3727/39/16/R01.

[SVH+08] U. Stöhr, P. Vulto, P. Hoppe, G. Urban, and H. Reinecke. High-resolution permanent photoresist laminate for microsystem applications. *J. Micro/Nanolith. MEMS MOEMS*, 7: 033009, 2008, http://dx.doi.org/10.1117/1.2964217.

[TAI06] H.M.L. Tan, T. Akagi, and T. Ichiki. Localized plasma treatment of poly(dimethylsiloxane) surfaces and its application to controlled cell cultivation. *J. Photopolym. Sci. Technol.*, 19: 245–250, 2006, http://dx.doi.org/10.2494/photopolymer.19.245.

[TEK06] M. Thomas, M. Eichler, and C.-P. Klages. Coating with atmospheric pressure plasma processes: From large area to µ-structures. In *49th Annual Technical Conference Proceedings*. Society of Vacuum Coaters, 2006, http://tinyurl.com/Thomas06.

[The] The LyX Team. Lyx 1.6.x. Internet: http://www.lyx.org.

[TJLH06] Y.-C. Tsai, H.-P. Jen, K.-W. Lin, and Y.-Z. Hsie. Fabrication of microfluidic devices using dry film photoresist for microchip capillary electrophoresis. *J. Chromatogr. A*, 1111: 267–271, 2006, http://dx.doi.org/10.1016/j.chroma.2005.12.003.

[Tow10] J.S. Townsend. *The Theory of Ionization of Gases by Collision*. Constable, 1910.

[Tow15] J.S. Townsend. *Electricity in Gases*. Clarendon Press, 1915.

[TvHKB07] M. Thomas, M. von Hausen, C.-P. Klages, and P. Baumhof. Generation of stable coatings with carboxylic groups by copolymerization of MAA and VTMS using DBD at atmospheric pressure. *Plasma Process. Polym.*, 4: S475–S481, 2007, http://dx.doi.org/10.1002/ppap.200731210.

[TWL03] D. Therriault, S.R. White, and J.A. Lewis. Chaotic mixing in three-dimensional microvascular networks fabricated by direct-write assembly. *Nature Materials*, 2(4): 265–271, 2003, http://dx.doi.org/10.1038/nmat863.

[TYL+06] Y.-C. Tsai, S.-J. Yang, H.-T. Lee, H.-P. Jen, and Y.-Z. Hsieh. Fabrication of a flexible and disposable microreactor using a dry film photoresist. *J. Chin. Chem. Soc.*, 53: 683–688, 2006, http://nr.stpi.org.tw/ejournal/ChiChemSociety/2006/EJ52-2006-683.pdf.

[U+72] S. Udenfriend et al. Fluorescamine: A reagent for assay of amino acids, peptides, proteins, and primary amines in the picomole range. *Science*, 178: 871–872, 1972, http://dx.doi.org/10.1126/science.178.4063.871.

[V+05a] T. Velten et al. Packaging of bio-mems: Strategies, technologies,

and applications. *IEEE trans. adv. packag.*, 28: 533 – 546, 2005, http://dx.doi.org/10.1109/TADVP.2005.858427.

[V+05b] P. Vulto et al. Microfluidic channel fabrication in dry film resist for production and prototyping of hybrid chips. *Lab on a Chip*, 5: 158 – 162, 2005, http://dx.doi.org/10.1039/b411885e.

[V+06] P. Vulto et al. Selective sample recovery of dep-separated cells and particles by phaseguide-controlled laminar flow. *J. Micromech. Microeng.*, 16: 1847 – 1853, 2006, http://dx.doi.org/10.1088/0960-1317/16/9/013.

[VIU07] P. Vulto, G. Igel, and G.A. Urban. Full wafer fabrication process for microfluidic glass chips with electroplated electrodes. In *Solid-State Sensors, Actuators and Microsystems Conference, 2007. TRANSDUCERS 2007.*, pages 117 – 120, 2007, http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4300085.

[VKIU06] P. Vulto, C. Klaunick, G. Igel, and G. Urban. tmRNA purification by electrophoretic filtration for genomic identification of bacteria on-a-chip. In *Proceedings of μTAS 2006*, volume 2, pages 377 – 379, 2006.

[VSH+05] K.D. Vora, B.Y. Shew, E.C. Harvey, J.P. Hayes, and A.G. Peele. Specification of mechanical support structures to prevent SU-8 stiction in high aspect ratio structures. *J. Micromech. Microeng.*, 15: 978 – 983, 2005, http://dx.doi.org/10.1088/0960-1317/15/5/012.

[W+05] Y. Washio et al. Multilayer ultra thick resist development for MEMS. In *Proceedings of SPIE*, volume 5753, page 959, 2005, http://dx.doi.org/10.1117/12.600227.

[WH06] C. Wang and X. He. Polypropylene surface modification model in atmospheric pressure dielectric barrier discharge. *Surface & Coatings Technology*, 201(6): 3377 – 3384, 2006, http://dx.doi.org/10.1016/j.surfcoat.2006.07.205.

[WW04] J.D. Williams and W. Wang. Microfabrication of an electromagnetic power relay using SU-8 based UV-LIGA technology. *Microsystem Technologies*, 10: 699 – 705, 2004, http://dx.doi.org/10.1007/s00542-004-0396-1.

[XLW+07] X. Xu, L. Li, S. Wang, L. Zhao, and T. Ye. Deposition of SiO_x films with a capacitively-coupled plasma at atmospheric pressure. *Plasma Sources Sci. Technol.*, 16(2): 372 – 376, 2007, http://dx.doi.org/10.1088/0963-0252/16/2/021.

[Y+06] L. Yu et al. Adhesive bonding with su-8 at wafer level for microfluidic devices. *J. Phys.: Conf. Ser.*, 34: 776 – 781, 2006, http://dx.doi.org/10.1088/1742-6596/34/1/128.

[Yas05] Hirotsugu Yasuda. *Luminous Chemical Vapor Deposition and Interface Engineering*, volume 122 of *Surfactant Science Series*. Marcel Dekker, 1st edition, 2005.

[YHK96] K. Yamada, T. Haraguchi, and T. Kajiyama. Plasma-graft polymerization of vinyl monomers with reactive groups onto a surface of poly (p-phenylene terephthalamide) fiber. *J. Appl. Polym. Sci.*, 60(11): 1847 – 1853, 1996, http://dx.doi.org/10.1002/(SICI)1097-4628(19960613)60:11<1847::AID-APP8>3.0.CO;2-L.

[ZCPC04] J. Zhang, M.B. Chan-Park, and S.R. Conner. Effect of exposure dose on the replication fidelity and profile of very high aspect ratio microchannels in SU-8. *Lab on a Chip*, 4: 646 – 653, 2004, http://dx.doi.org/10.1039/b403304c.

[ZKN+01] X.P. Zou, E.T. Kang, K.G. Neoh, C.Q. Cui, and T.B. Lim. Surface modification of poly (tetrafluoroethylene) films by plasma polymerization of glycidyl methacrylate for adhesion enhancement with evaporated copper. *Polymer*, 42(15): 6409 – 6418, 2001, http://dx.doi.org/10.1016/S0032-3861(01)00113-6.

[ZKUI95] J. Zhang., K. Kato, Y. Uyama, and Y. Ikada. Surface graft polymerization of glycidyl methacrylate onto polyethylene and the adhesion with epoxy resin. *J. Polymer Sci. Polymer Chem.*, 33(15): 2629 – 2638, 1995, http://dx.doi.org/10.1002/pola.1995.080331509.

[ZU99] Y. Zhao and M.-W. Urban. Spectroscopic studies of microwave plasma reactions of maleic anhydride on poly (vinylidene fluoride) surfaces: crystallinity and surface reactions. *Langmuir*, 15(10): 3538 – 3544, 1999, http://dx.doi.org/10.1021/la981310m.

Nomenclatura

R_a	arithmetic average roughness
PPS	Polyphenylene sulfide
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