



Universiteit
Leiden
The Netherlands

Interference effects with surface plasmons

Kuzmin, N.V.

Citation

Kuzmin, N. V. (2008, January 10). *Interference effects with surface plasmons. Casimir PhD Series*. LION, Quantum Optics Group, Faculty of Science, Leiden University. Retrieved from <https://hdl.handle.net/1887/12551>

Version: Corrected Publisher's Version

[Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

License: <https://hdl.handle.net/1887/12551>

Note: To cite this publication please use the final published version (if applicable).

Interference Effects with Surface Plasmons

Nikolay Victorovich Kuzmin

Interference Effects with Surface Plasmons

Proefschrift

ter verkrijging van
de graad van Doctor aan de Universiteit Leiden,
op gezag van Rector Magnificus prof.mr. P.F. van der Heijden,
volgens besluit van het College voor Promoties
te verdedigen op donderdag 10 januari 2008
klokke 15:00 uur

door

Nikolay Victorovich Kuzmin

geboren te Troitsk, Rusland
in 1980

Promotiecommissie:

Promotor:	Prof. Dr. G.W. 't Hooft	(Philips Research / Universiteit Leiden)
Copromotor:	Dr. E.R. Eliel	(Universiteit Leiden)
Referent:	Dr. J. Gómez Rivas	(AMOLF / Philips Research)
Leden:	Prof. Dr. L. Kuipers	(AMOLF / Universiteit Twente)
	Prof. Dr. H.P. Urbach	(Technische Universiteit Delft)
	Prof. Dr. M.W. Beijersbergen	(Cosine / Universiteit Leiden)
	Dr. M.P. van Exter	(Universiteit Leiden)
	Prof. Dr. J.P. Woerdman	(Universiteit Leiden)
	Prof. Dr. J.M. van Ruitenbeek	(Universiteit Leiden)

The work presented in this thesis is part of the scientific program of the “Stichting voor Fundamenteel Onderzoek der Materie (FOM)” and has been made possible by financial support from the “Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO)”.

Casimir PhD Series, Delft-Leiden, 2008-01
ISBN/EAN: 978-90-9022593-7

*Моим родителям и моей сестре
Aan mijn ouders en mijn zuster*

Contents

1	Introduction	1
1.1	Basic properties of metals	1
1.2	Surface plasmons	2
1.2.1	What is a surface plasmon?	2
1.2.2	Surface plasmon dispersion and attenuation	5
1.2.3	Surface-plasmon excitation	6
1.3	Outline of thesis	9
2	Plasmon-assisted two-slit transmission: Young's experiment revisited	13
2.1	Introduction	14
2.2	Idea	14
2.3	Experiment	14
2.4	Results	15
2.5	Theoretical calculation	19
2.6	Conclusions	21
2.7	Appendix: Erasing the interference	22
3	Enhanced spatial coherence by surface plasmons	27
3.1	Introduction	28
3.2	Experiment	29
3.3	Results	29
3.4	Conclusions	33

4 Bouncing surface plasmons	35
4.1 Introduction	36
4.2 Experiment	37
4.3 Results	39
4.4 Discussion	41
4.5 Conclusions	47
4.6 Appendix: Slowed-down surface plasmons	48
5 Phase factors in light-plasmon scattering	51
5.1 Introduction	52
5.2 Heuristic models	54
5.2.1 Two-slit system	55
5.2.2 Three-slit system	55
5.3 Experimental setup	58
5.4 Results and Discussion	59
5.4.1 Signal modulation along the slanted slit	60
5.4.2 Coupling phase slip	62
5.4.3 Plasmon tunneling	64
5.4.4 Slanted slit as a source of surface plasmons	65
5.5 Conclusions	67
5.6 Appendix: Towards a complete picture of surface-plasmon scattering	68
6 Retardation effects in sub-wavelength slits in thin metal films near cut-off	73
6.1 Introduction	74
6.2 Experiment	77
6.3 Experimental results	78
6.3.1 Transmission of purely TE/TM polarized incident light.	79
6.3.2 Polarization analysis of transmitted light	80
6.4 Discussion	83
6.5 Conclusions	87
7 Short-wavelength surface plasmons	89
7.1 Introduction	90
7.2 Dispersion and Damping	90
7.3 Experiment	91
7.4 Results and Discussion	93
7.5 Conclusions	98

Bibliography	99
Samenvatting	109
Интерференционные эффекты с поверхностными плазмонами (in Russian)	
Волны в природе	117
Поверхностные плазмоны	118
Тема и содержание диссертации	122
Curriculum Vitae	135
Acknowledgements	137
List of publications	139

