



Universiteit
Leiden
The Netherlands

Nonlinear optical studies of single gold nanoparticles

Dijk, M.A. van

Citation

Dijk, M. A. van. (2007, October 17). *Nonlinear optical studies of single gold nanoparticles*. *Casimir PhD Series*. Retrieved from <https://hdl.handle.net/1887/12380>

Version: Corrected Publisher's Version

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

Downloaded from: <https://hdl.handle.net/1887/12380>

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

Nonlinear-optical studies of single gold nanoparticles

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 woensdag 17 oktober 2007
klokke 13.45 uur

door

Meindert Alexander van Dijk
geboren te Zaanstad
in 1979

Promotiecommissie:

Promotor: Prof. Dr. M. A. G. J. Orrit
Copromotor: Prof. Dr. M. O. Lippitz (Universität Stuttgart)
Referent: Prof. Dr. N. F. van Hulst (ICFO Barcelona)
Overige Leden: Prof. Dr. V. Sandoghdar (ETH Zürich)
Prof. Dr. E. J. J. Groenen
Prof. Dr. J. M. van Ruitenbeek
Prof. Dr. J. P. Woerdman

voor Paul en Jenny

Contents

Preface	7
1 Gold nanoparticles	11
1.1 Introduction	11
1.2 Linear optical properties	12
1.3 Ultrafast dynamics	24
1.4 Detection techniques	31
2 Third-harmonic generation	35
2.1 Introduction	35
2.2 Experimental method	36
2.3 Single gold nanoparticles	38
2.4 Size dependence	41
2.5 Conclusion	42
3 Characterization of a common-path interferometer	45
3.1 Introduction	45
3.2 Description of the setup	47
3.3 Model of the interferometer	51
3.4 Results and discussion	55
3.5 Conclusion	59
4 Acoustic vibrations of single gold nanoparticles	61
4.1 Introduction	61
4.2 Experimental method	63
4.3 Imaging single gold nanoparticles	65
4.4 Time-resolved experiments	65
4.5 Vibrational modes	69
4.6 Conclusion	71

Contents

5 Correlation of optical and structural properties	73
5.1 Introduction	73
5.2 Combination of white-light spectroscopy and pump-probe interferometry	74
5.3 Statistical analysis of single-particle pump-probe dynamics . .	84
5.4 A closer look at ellipsoidal deformation	93
5.5 Conclusion	99
Bibliography	100
Samenvatting	113
Nawoord	121
List of Publications	123
Curriculum Vitae	125