materials

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Supplementary materials

# "DIY" Silica Nanoparticles: Exploring the Scope of a Simplified Synthetic Procedure and Absorbance-Based Diameter Measurements

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**Table S1.** Tabularized data for all silica nanoparticle samples.

| Series / | Volume of reagents (mL) | | | Molar concentration of reagents (mol·L$^{-1}$) | | | | Product | TEM data (nm) | | Calculated data | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| sample | TEOS | $NH_3$ | $H_2O$ | TEOS | $NH_3$ | $H_2O$ | EtOH | $[NH_3]\cdot[H_2O]]$ | $d$ | $SD_d$ | $\tau_{sp}$ (cm$^{-1}$) | $d_{calc}$ (nm) |
| **1/1** | 0.40 | 0.40 | 9.20 | 0.1805 | 0.5343 | 3.1700 | 15.5287 | 1.6938 | 63.280 | 7.930 | - | - |
| **1/2** | 0.40 | 0.50 | 9.10 | 0.1805 | 0.6679 | 3.5309 | 15.3599 | 2.3583 | 131.463 | 12.245 | - | - |
| **1/3** | 0.40 | 0.60 | 9.00 | 0.1805 | 0.8015 | 3.8918 | 15.1911 | 3.1192 | 253.835 | 12.943 | - | - |
| **1/4** | 0.40 | 0.70 | 8.90 | 0.1805 | 0.9351 | 4.2526 | 15.0223 | 3.9765 | 266.276 | 14.552 | - | - |
| **1/5** | 0.40 | 0.80 | 8.80 | 0.1805 | 1.0686 | 4.6135 | 14.8535 | 4.9302 | 294.691 | 17.411 | - | - |
| **1/6** | 0.40 | 0.90 | 8.70 | 0.1805 | 1.2022 | 4.9744 | 14.6848 | 5.9803 | 291.014 | 19.598 | - | - |
| **1/7** | 0.40 | 1.00 | 8.60 | 0.1805 | 1.3358 | 5.3352 | 14.5160 | 7.1268 | 299.843 | 15.334 | - | - |
| **1/8** | 0.40 | 1.10 | 8.50 | 0.1805 | 1.4694 | 5.6961 | 14.3472 | 8.3697 | 299.820 | 16.031 | - | - |
| **1/9** | 0.40 | 1.20 | 8.40 | 0.1805 | 1.6030 | 6.0570 | 14.1784 | 9.7090 | 317.531 | 16.330 | - | - |
| **1/10** | 0.40 | 1.30 | 8.30 | 0.1805 | 1.7365 | 6.4178 | 14.0096 | 11.1448 | 325.260 | 16.752 | - | - |
| **1/11** | 0.40 | 1.40 | 8.20 | 0.1805 | 1.8701 | 6.7787 | 13.8408 | 12.6769 | 337.832 | 11.420 | - | - |
| **1/12** | 0.40 | 1.50 | 8.10 | 0.1805 | 2.0037 | 7.1396 | 13.6720 | 14.3055 | 353.191 | 18.574 | - | - |
| **1/13** | 0.40 | 1.60 | 8.00 | 0.1805 | 2.1373 | 7.5004 | 13.5032 | 16.0305 | 373.210 | 21.221 | - | - |
| **1/14** | 0.40 | 1.80 | 7.80 | 0.1805 | 2.4044 | 8.2221 | 13.1656 | 19.7697 | 383.613 | 20.744 | - | - |
| **1/15** | 0.40 | 2.00 | 7.60 | 0.1805 | 2.6716 | 8.9439 | 12.8281 | 23.8945 | 386.761 | 17.463 | - | - |
| **1/16** | 0.40 | 2.20 | 7.40 | 0.1805 | 2.9388 | 9.6656 | 12.4905 | 28.4049 | 395.760 | 17.181 | - | - |
| **1/17** | 0.40 | 2.40 | 7.20 | 0.1805 | 3.2059 | 10.3873 | 12.1529 | 33.3010 | 405.391 | 14.122 | - | - |
| **1/18** | 0.40 | 2.60 | 7.00 | 0.1805 | 3.4731 | 11.1091 | 11.8153 | 38.5827 | 420.410 | 14.363 | - | - |
| **2/1** | 0.40 | 0.36 | 9.24 | 0.1805 | 0.4809 | 1.4470 | 16.2136 | 0.6958 | 13.242 | 2.750 | 28.737 | 51.943 |
| **2/2** | 0.40 | 0.38 | 9.22 | 0.1805 | 0.5076 | 1.5225 | 16.1785 | 0.7728 | 19.647 | 3.122 | 28.198 | 51.910 |
| **2/3** | 0.40 | 0.40 | 9.20 | 0.1805 | 0.5343 | 1.5981 | 16.1434 | 0.8539 | 25.812 | 3.528 | 52.422 | 52.716 |
| **2/4** | 0.40 | 0.42 | 9.18 | 0.1805 | 0.5610 | 1.6737 | 16.1083 | 0.9390 | 27.825 | 4.043 | 54.389 | 52.785 |
| **2/5** | 0.40 | 0.44 | 9.16 | 0.1805 | 0.5878 | 1.7493 | 16.0732 | 1.0282 | 33.458 | 4.646 | 76.335 | 53.639 |
| **2/6** | 0.40 | 0.46 | 9.14 | 0.1805 | 0.6145 | 1.8249 | 16.0381 | 1.1213 | 40.472 | 4.938 | 104.079 | 54.624 |
| **2/7** | 0.40 | 0.48 | 9.12 | 0.1805 | 0.6412 | 1.9005 | 16.0030 | 1.2186 | 44.143 | 5.658 | 141.553 | 55.935 |
| **2/8** | 0.40 | 0.50 | 9.10 | 0.1805 | 0.6679 | 1.9761 | 15.9679 | 1.3198 | 47.778 | 6.292 | 172.340 | 57.013 |
| **2/9** | 0.40 | 0.52 | 9.08 | 0.1805 | 0.6946 | 2.0517 | 15.9328 | 1.4251 | 53.635 | 6.969 | 298.965 | 61.445 |
| **2/10** | 0.40 | 0.54 | 9.06 | 0.1805 | 0.7213 | 2.1273 | 15.8977 | 1.5345 | 61.214 | 7.524 | 409.897 | 65.327 |
| **2/11** | 0.40 | 0.56 | 9.04 | 0.1805 | 0.7480 | 2.2029 | 15.8626 | 1.6478 | 67.213 | 9.311 | 537.734 | 69.801 |
| **2/12** | 0.40 | 0.58 | 9.02 | 0.1805 | 0.7748 | 2.2784 | 15.8275 | 1.7653 | 72.103 | 9.919 | 587.579 | 71.546 |
| **2/13** | 0.40 | 0.60 | 9.00 | 0.1805 | 0.8015 | 2.3540 | 15.7924 | 1.8867 | 81.944 | 11.922 | 820.209 | 79.688 |
| **2/14** | 0.40 | 0.70 | 8.90 | 0.1805 | 0.9351 | 2.7320 | 15.6170 | 2.5546 | 101.456 | 13.419 | 1273.814 | 95.564 |
| **2/15** | 0.40 | 0.75 | 8.85 | 0.1805 | 1.0018 | 2.9210 | 15.5292 | 2.9264 | 131.319 | 21.545 | 2191.105 | 127.670 |
| **2/16** | 0.40 | 0.90 | 8.70 | 0.1805 | 1.2022 | 3.4879 | 15.2660 | 4.1932 | 277.079 | 10.215 | 6079.522 | 263.764 |
| **2/17** | 0.40 | 1.50 | 8.10 | 0.1805 | 2.0037 | 5.7556 | 14.2132 | 11.5325 | 348.721 | 11.889 | 8590.091 | 351.634 |
| **2/18** | 0.40 | 2.40 | 7.20 | 0.1805 | 3.2059 | 9.1572 | 12.6340 | 29.3571 | 396.782 | 9.086 | 8037.985 | 332.310 |
| **3/1** | 0.40 | 0.40 | 9.20 | 0.1805 | 0.5343 | 1.5981 | 16.1434 | 0.8539 | 26.321 | 3.911 | 35.928 | 52.239 |
| **3/2** | 0.40 | 0.45 | 9.15 | 0.1805 | 0.6011 | 1.7871 | 16.0557 | 1.0742 | 39.112 | 4.578 | 120.566 | 55.201 |
| **3/3** | 0.40 | 0.50 | 9.10 | 0.1805 | 0.6679 | 1.9761 | 15.9679 | 1.3198 | 48.213 | 6.835 | 230.532 | 59.045 |
| **3/4** | 0.40 | 0.55 | 9.05 | 0.1805 | 0.7347 | 2.1651 | 15.8802 | 1.5906 | 65.781 | 9.023 | 450.968 | 66.765 |
| **3/5** | 0.40 | 0.60 | 9.00 | 0.1805 | 0.8015 | 2.3540 | 15.7924 | 1.8867 | 82.094 | 12.012 | 880.776 | 81.808 |
| **3/6** | 0.40 | 0.65 | 8.95 | 0.1805 | 0.8683 | 2.5430 | 15.7047 | 2.2080 | 95.679 | 12.982 | 1325.178 | 97.362 |
| **3/7** | 0.40 | 0.70 | 8.90 | 0.1805 | 0.9351 | 2.7320 | 15.6170 | 2.5546 | 114.135 | 14.452 | 1804.655 | 114.144 |
| **3/8** | 0.40 | 0.75 | 8.85 | 0.1805 | 1.0018 | 2.9210 | 15.5292 | 2.9264 | 136.078 | 15.676 | 2311.671 | 131.889 |

**Code S1.** Maple code for calculation of $Q_{scat}$ and $\tau_{sp}$ using Mie theory.

```
> Digits := 24;
> lambda0:=400;        # incident wavelength in nanometers
> eta_p:=w->c1*(-40.596*w^5+93.805*w^4-86.36*w^3+39.876*w^2-9.3768*w+2.3822);
> eta_m:=w->c2*(-26.231*w^5+63.835*w^4-61.969*w^3+30.217*w^2-7.5228*w+2.1481);
# polynomial fits for data from Ref. [39]
> c1:=1.0;  # used to simulate non-ideal material; see Figure 3(a)
> c2:=1.0;  # used to simulate non-ideal medium; see Figure 3(a)
> lambda_m:= lambda0/eta_m((1e-3)*lambda0);
> m:=eta_p(lambda0*1e-3)/eta_m(lambda0*1e-3);
> alpha0:=evalf(Pi/lambda_m);          # from Eq. (6) alpha=Pi/lambda_m*d=alpha0*d
> psi:=(n,z)->sqrt(Pi*z/2)*BesselJ(n+1/2,z);
> psi_p:=(n,z)->D[2](psi)(n,z);
> zeta:=(n,z)->sqrt(Pi*z/2)*(BesselJ(n+1/2,z)+I*(-1)^n*BesselJ(-n-1/2,z));
> zeta_p:=(n,z)->D[2](zeta)(n,z);
> An:=(n,z)->psi_p(n,z)/psi(n,z);
> an:=(n,x,y)->(An(n,y)*psi(n,x)-m*psi_p(n,x))/(An(n,y)*zeta(n,x)-m*zeta_p(n,x));       # Eq. (10) in Ref. [36]
> bn:=(n,x,y)->(m*An(n,y)*psi(n,x)-psi_p(n,x))/(m*An(n,y)*zeta(n,x)-zeta_p(n,x));       # Eq. (11) in Ref. [36]
> nmax:=70;
> Qscat:=(nmax,x,y)-
>2/x^2*add((2*n+1)*(an(n,x,y)*conjugate(an(n,x,y))+bn(n,x,y)*conjugate(bn(n,x,y))),n=1..nmax);
# Eq. (5) in Ref. [36]
> plot(Qscat(nmax,alpha0*d,alpha0*m*d), d=10..5000);
> tau_sp:=(nmax,x,y,d)->(3/(2*d))*Qscat(nmax,x,y);
> plot(tau_sp(nmax,alpha0*d,alpha0*m*d,d),d=0..350); # by default tau_sp values will be calculated in nm^-
1
```