**Supplementary Materials**

**Photothermal Effects and Heat Conduction in Nanogranular Silicon Films**

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| **Figure S1**. SEM images before (left) and after (right) ImageJ processing for porosity estimation. | |

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| **(a)** | **(b)** |
|  |  |
| **(c)** | **(d)** |
| **Figure S2.** Maps of the absorbed power density (in W/m3, ×1015) at different depths (z) of 4 µm thick porous Si NPs film on 4 µm thick glass substrate: (a) z = 0.1 µm, (b) z = 1 µm, (c) z = 2 µm, (d) z = 3 µm. | |

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| Table S1. Room temperature thermal conductivity values of nanostructured porous Si.  Photoacoustic method = PA, Phonon hydrodynamics calculations = PH, Monte Carlo simulation = MC, Volkein’s DC method = VDC; Optical pump-probe technique = OPP; Lock-in thermography = LT; Scanning thermal microscopy = SThM; Molecular Dynamics Simulation = MD; Finite element mesh = FEM; Electrothermal response = ETR; Laser flash method = LF; Born-von Karman model = BK; Effective medium model = EM; Electron beam heating method = EBH; Two-laser Raman thermography = TLRT; | | | | | |
| Porous Si layer thickness(micron) | Porosity,  % | Thermal conductivity (W/m K) | Measurement/ calculation technique | Sample description | Reference |
| **Porous Si** | | | | | |
| 10 | 50 | 3.9 | PA | c-Por-Si, p+ type, anodization-etched | [34] |
| 23 | 60 | 2.5 | PA | c-Por-Si, p+ type, anodization-etched | [34] |
| 75 | 40 | 31.2 | PA | c-Por-Si, n- type, electrochemical anodic-etched | [34] |
| 180 | 40 | 31.2 | PA | c-Por-Si, n- type, d = 200-500 nm, electrochemical anodic-etched | [34] |
| 100 | 66 | 3.3 | 3*𝜔* | c-Por-Si, n type, d = 47nm(pore diameter), electrochemical etched | [29] |
| 100 | 43 | 3.7 | 3*𝜔* | c-Por-Si, n type, d=27nm(pore diameter), electrochemical etched | [29] |
| 100 | 40 | 5.5 | 3*𝜔* | c-Por-Si, n type, d=35nm(pore diameter), electrochemical etched | [29] |
| 100 | 33 | 5 | 3*𝜔* | c-Por-Si, n type, d=32nm(pore diameter), electrochemical etched | [29] |
| 100 | 17 | 13.7 | 3*𝜔* | c-Por-Si, n type, d=64nm(pore diameter), electrochemical etched | [29] |
| 100 | 60 | 17.6 | 3*𝜔* | c-Por-Si, n type, d=235nm(pore diameter), electrochemical etched | [29] |
| 100 | 42 | 24 | 3*𝜔* | c-Por-Si, n type, electrochemical etched | [29] |
| - | 40 | 1 | PH | c-Por-Si | [44] |
| 75 | 40 | 29.6 | PH | c-Por-Si, p+ type, anodization-etched | [44] |
| 10 | 50 | 5.9 | PH | c-Por-Si, p+ type, anodization-etched | [44] |
| 23 | 60 | 4 | PH | c-Por-Si, p+ type, anodization-etched | [44] |
| 31 | 64 | 0.29 | PH | c-Por-Si, p-type, boron-doped, electrochemical etched | [44] |
| 46 | 71 | 0.16 | PH | c-Por-Si, p-type, boron-doped, electrochemical etched | [44] |
| 31 | 79 | 0.10 | PH | c-Por-Si, p-type, boron-doped, electrochemical etched | [44] |
| 31 | 89 | 0.02 | PH | c-Por-Si, p-type, boron-doped, electrochemical etched | [44] |
| 0.25 | 15.9 | 21.9 | TLRT | c-Si membrane, d = 135 nm(pore diameter) | [58] |
| 0.25 | 24.6 | 8.5 | TLRT | c-Si membrane,d = 135 nm(pore diameter) | [58] |
| 0.25 | 33.2 | 3.9 | TLRT | c-Si membrane,d = 135 nm(pore diameter) | [58] |
| 310 | 71 | 0.15 | 3*𝜔* | c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [37] |
| 46 | 71 | 0.15 | 3*𝜔* | c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [37] |
| 31 | 64 | 0.20 | 3*𝜔* | c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [37] |
| 31 | 79 | 0.04 | 3*𝜔* | c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [37] |
| 31 | 89 | 0.03 | 3*𝜔* | c-Por-Si, p+-type, high-doped, electrochemical etched, on si substrate | [37] |
| 0.05 | 30 | 5.5 | MC | c-Por-Si, p+ type, electrochemical etched | [45] |
| 0.15 | 30 | 5.6 | MC | c-Por-Si, p+ type, electrochemical etched | [45] |
| 0.26 | 30 | 6.2 | MC | c-Por-Si, p+ type, electrochemical etched | [45] |
| 0.5 | 30 | 6.4 | MC | c-Por-Si, p+ type, electrochemical etched | [45] |
| 1 | 30 | 6.5 | MC | c-Por-Si, p+ type, electrochemical etched | [45] |
| 45 | 40 | 2.93 | PA | c-Por-Si, macro, micro, nano mixed porous, n type, el.etched | [30] |
| 60 | 57 | 1.03 | PA | c-Por-Si, macro, micro, nano mixed porous, n type, el.etched | [30] |
| 40 | 72 | 0.29 | PA | c-Por-Si, macro, micro, nano mixed porous, n type, el.etched | [30] |
| 4.84 | 0.23 | 0.55 | VDC | d = 10.9(pore diameter), n type PS | [46] |
| 4.45 | 0.23 | 0.55 | VDC | d = 10.9(pore diameter), n type PS | [46] |
| 4.49 | 0.26 | 0.39 | VDC | d = 2.3(pore diameter), n type PS | [46] |
| 4.57 | 0.26 | 0.4 | VDC | d = 2.3(pore diameter), n type PS | [46] |
| 23 | 60 | 6.1 | PH | R = 10(pore radius), c-Por-Si, p+ type, anodization-etched | [47] |
| 31 | 64 | 2.17 | PH | R = 2(pore radius), c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [47] |
| 46 | 71 | 1.56 | PH | R = 2(pore radius), c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [47] |
| 31 | 79 | 0.99 | PH | R = 3(pore radius), c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [47] |
| 31 | 89 | 0.18 | PH | R = 5(pore radius), c-Por-Si, p-type, boron-doped, electrochemical etched, on si substrate | [47] |
| 19 | 61 | 0.15 | OPP | c-Por-Si, p type, electrochemical etched | [39] |
| 27 | 66 | 0.13 | OPP | c-Por-Si, p type, electrochemical etched | [39] |
| 38 | 73 | 0.17 | OPP | c-Por-Si, p type, electrochemical etched | [39] |
| 3.2 | 27.5 | 20.8 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 20.8 | 37.2 | 12.7 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 20.7 | 44.2 | 11.3 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 25.1 | 48.4 | 8.7 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 26.8 | 51.7 | 6.1 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 26.9 | 58.8 | 4.5 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 25.5 | 66.2 | 2.3 | LT | c-Por-Si, d=100nm, p-type, boron doped, etched-sintered | [31] |
| 26 | 55 | 1.93 | PA | c-Por-Si, p-type, nitrided, KOH etched | [32] |
| 26 | 55 | 1.12 | PA | c-Por-Si, p-type, anodized, KOH etched | [32] |
| 26 | 75 | 0.74 | PA | c-Por-Si, p-type, nitrided, KOH etched | [32] |
| 26 | 75 | 0.95 | PA | c-Por-Si, p-type, anodized, KOH etched | [32] |
| 0.26076 | 80 | 0.95013 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 0.55281 | 80 | 1.23833 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 0.86159 | 80 | 1.55207 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 1.10155 | 80 | 1.40869 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 1.63169 | 80 | 1.61738 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 3.27791 | 80 | 1.43424 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 4.66557 | 80 | 1.49954 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 5.62541 | 80 | 1.47399 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 0.26076 | 80 | 0.95013 | SThM | c-Por-Si, p+-type, boron doped, electrochemical dissolution | [33] |
| 100 | 74 | 0.3 | Raman | c-Por-Si, p+-type, mesoporous, anodic dissolution process | [35] |
| 0.054 | 15 | 3.91 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3nm, N(pore number) = 99 | [57] |
| 0.081 | 15 | 4.26 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3nm, N(pore number) = 153 | [57] |
| 0.1 | 15 | 4.67 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3nm, N(pore number) = 198 | [57] |
| 0.135 | 15 | 4.77 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3nm, N (pore number)= 252 | [57] |
| 0.054 | 25 | 2.12 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.5nm, N(pore number) = 99 | [57] |
| 0.081 | 25 | 2.26 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.5nm, N(pore number) = 153 | [57] |
| 0.1 | 25 | 2.37 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.5nm, N(pore number) = 198 | [57] |
| 0.135 | 25 | 2.48 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.5nm, N(pore number) = 252 | [57] |
| 0.054 | 35 | 1.09 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.9nm, N(pore number) = 99 | [57] |
| 0.081 | 35 | 1.28 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.9nm, N (pore number)= 153 | [57] |
| 0.1 | 35 | 1.20 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.9nm, N(pore number) = 198 | [57] |
| 0.135 | 35 | 1.31 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 3.9nm, N(pore number) = 252 | [57] |
| 0.054 | 45 | 0.65 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 4.3nm, N(pore number) = 99 | [57] |
| 0.081 | 45 | 0.73 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 4.3nm, N(pore number) = 153 | [57] |
| 0.1 | 45 | 0.70 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 4.3nm, N(pore number) = 198 | [57] |
| 0.135 | 45 | 0.75 | MD | Bulk c-Si matrix, simulation cell length 24 – 136nm, D(pore) = 4.3nm, N(pore number) = 252 | [57] |
| bulk | 8 | 1.5 | MD | 6x6x6 contained unit cell, side length 3.258nm, D(pore) = 1.74nm | [48] |
| bulk | 15 | 2.5 | MD | 6x6x6 contained unit cell, side length 3.258nm, D(pore) = 1.74nm D(pore) = 2.17nm | [48] |
| bulk | 27 | 4.5 | MD | 6x6x6 contained unit cell, side length 3.258nm, D(pore) = 1.74nm D(pore) = 2.61nm | [48] |
| bulk | 38 | 9 | MD | 6x6x6 contained unit cell, side length 3.258nm, D(pore) = 1.74nm D(pore) = 2.93nm | [48] |
| 22 | 55 | 1.08 | 3*𝜔* | c-Por-Si, p-type, electrochemical anodization | [36] |
| 25 | 75 | 0.8 | SThM | a-P0r-Si, p+-type, electrochemical etched | [51] |
| 100 | 72 | 0.5(3w) | 3*𝜔* | c-Por-Si, p+-type, electrochemical etched | [40] |
| 48 | 41 | 5 | FEM, PT | c-Por-Si, n-type, electrochemical etched | [41] |
| 10 | 56 | 1.2 | Raman, SThM | a-PSi, p+-type, electrochemical etched | [52] |
| 100 | 20 | 4.2 | ETR, FEM | c-Por-Si, n-type, anodization | [42] |
| 50 | 45 | 2.3 | PA | c-Por-Si, p-type, electrochemical etched | [53] |
| 50 | 55 | 1.8 | PA | c-Por-Si, p-type, electrochemical etched | [53] |
| 50 | 65 | 1.4 | PA | c-Por-Si, p-type, electrochemical etched | [53] |
| 26.6 | 23 | 1.2 | PA | c-Por-Si, p-type, electrochemical anodic etched | [38] |
| 27.2 | 37 | 0.3 | PA | c-Por-Si, p-type, electrochemical anodic etched | [38] |
| 28.3 | 52 | 0.25 | PA | c-Por-Si, p-type, electrochemical anodic etched | [38] |
| 30 | 61 | 0.2 | PA | c-Por-Si, p-type, electrochemical anodic etched | [38] |
| **Si NP tablets** | | | | | |
| bulk | 30 | 1.5 | LF | c-Si NP, DNP =5.6nm, Spark plasma sintered | [24] |
| bulk | 30 | 2 | LF | c-Si NP, DNP =60nm,Spark plasma sintered | [24] |
| bulk | 9 | 25.7 | BK | c-Si NP, DNP = 70nm,Spark plasma sintered | [25] |
| bulk | 4.8 | 21.8 | BKl | c-Si NP, DNP = 60nm,Spark plasma sintered | [25] |
| bulk | 5.2 | 13.5 | BK | c-Si NP, DNP = 40nm,Spark plasma sintered | [25] |
| bulk |  | 10 | LF | c-Si NG, DNP = 5-20nm, dc hot pressed. | [27] |
| bulk |  | 10 | Calculated from thermal diffusivity | c-Si NP, DNP = 5-1-nm, ball milled and sintered | [28] |
| bulk | 17 | 6 | 3 | Si NC, DNP = 64nm | [26] |
| **Si NW films** | | | | | |
| 1 | 85 | 1.7 | 3 | c-Por-Si NWs, n-type, DNW = 80-90 nm, etched | [55] |
| 1 | 85 | 7.5 | EM | c-Por-Si NWs, n-type, DNW = 80-90 nm | [55] |
| 20 | 50 | 0.29 | Raman-Fourier | D(beam) = 1 micron, c-Si NW, 50%, d=150nm, p-type,met.assist.chem.etch., | [54] |
| 35 | 50 | 0.25 | Raman-Fourier | D(beam) = 1 micron, c-Si NW, 50%, d=150nm, p-type,met.assist.chem.etch. | [54] |
| 20 | 50 | 0.54 | Raman-Fourier | D(beam) = 2 micron, c-Si NW, 50%, d=150nm, p-type,met.assist.chem.etch. | [54] |
| 35 | 50 | 0.36 | Raman-Fourier | D(beam) = 2 micron, c-Si NW, 50%, d=150nm, p-type,met.assist.chem.etch. | [54] |
| 0.05 | 43 | 0.33 | EBH | c-Por-Si NWs , DNW = 8nm, etched | [56] |
| 20 | 50-55 | 7.3 | PA | c-Por-Si NWs, DNW =100nm, p-type, met.assis.chemical etched | [53] |
| 35 | 50-55 | 6.2 | PA | c-Por-Si NWs, DNW =100nm , p-type, met.assis.chemical etched | [53] |
| 50 | 50-55 | 5.6 | PA | c-Por-Si NWs, DNW =100nm , p-type, met.assis.chemical etched | [53] |