Porous Silicon

L. T. Canham, *Appl. Phys. Lett.* 57 (1990) 1046.

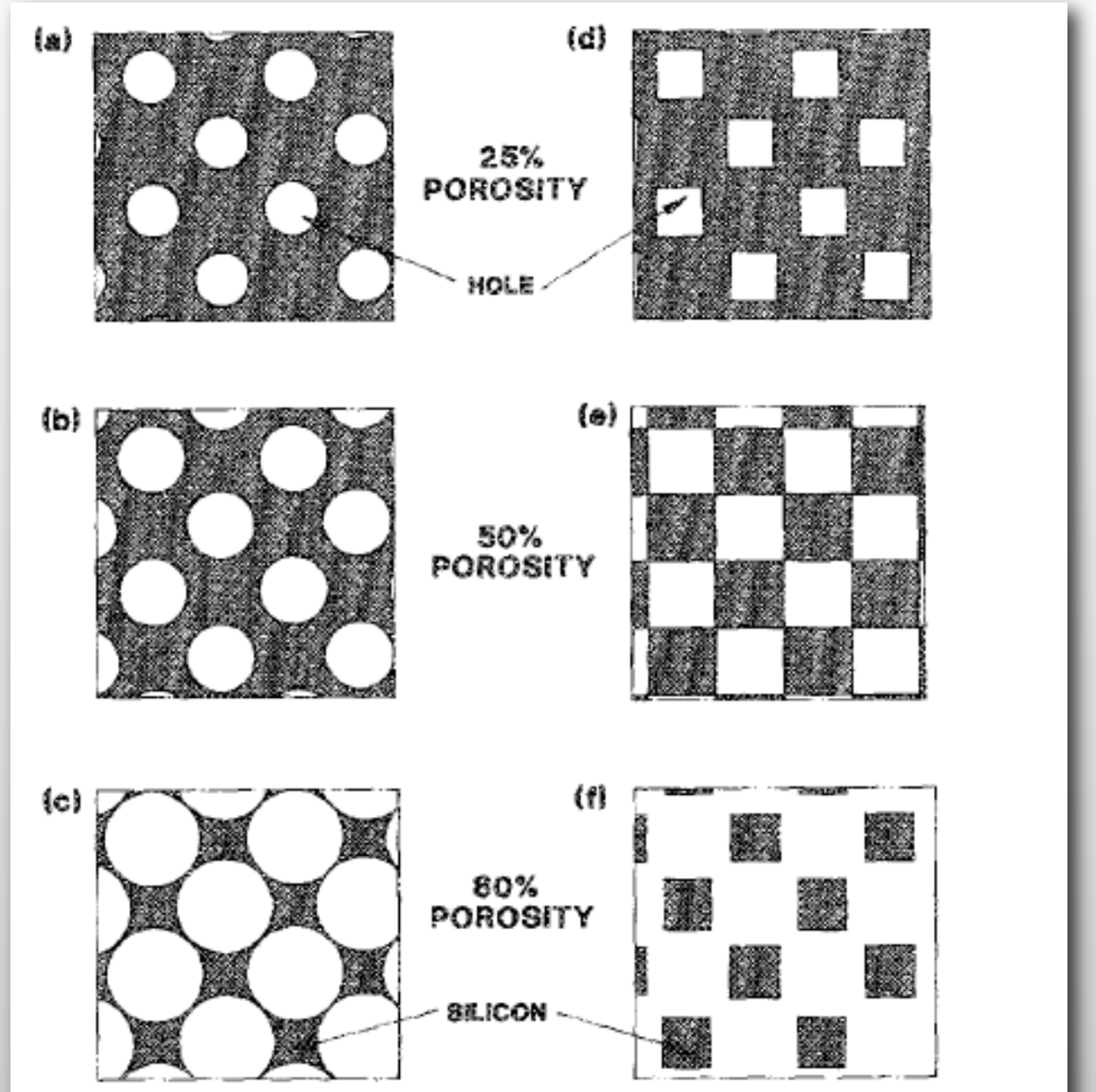

FIG. 1. Idealized plan view of an anodized (100) Si wafer containing (a)–(c) cylindrical holes, (d)–(f) rectangular holes. The indicated changes in porosity are achieved by pore enlargement through chemical dissolution.

Silicon at various stages of electrochemical etching. The etching bath contains HF which chemically etches as well.

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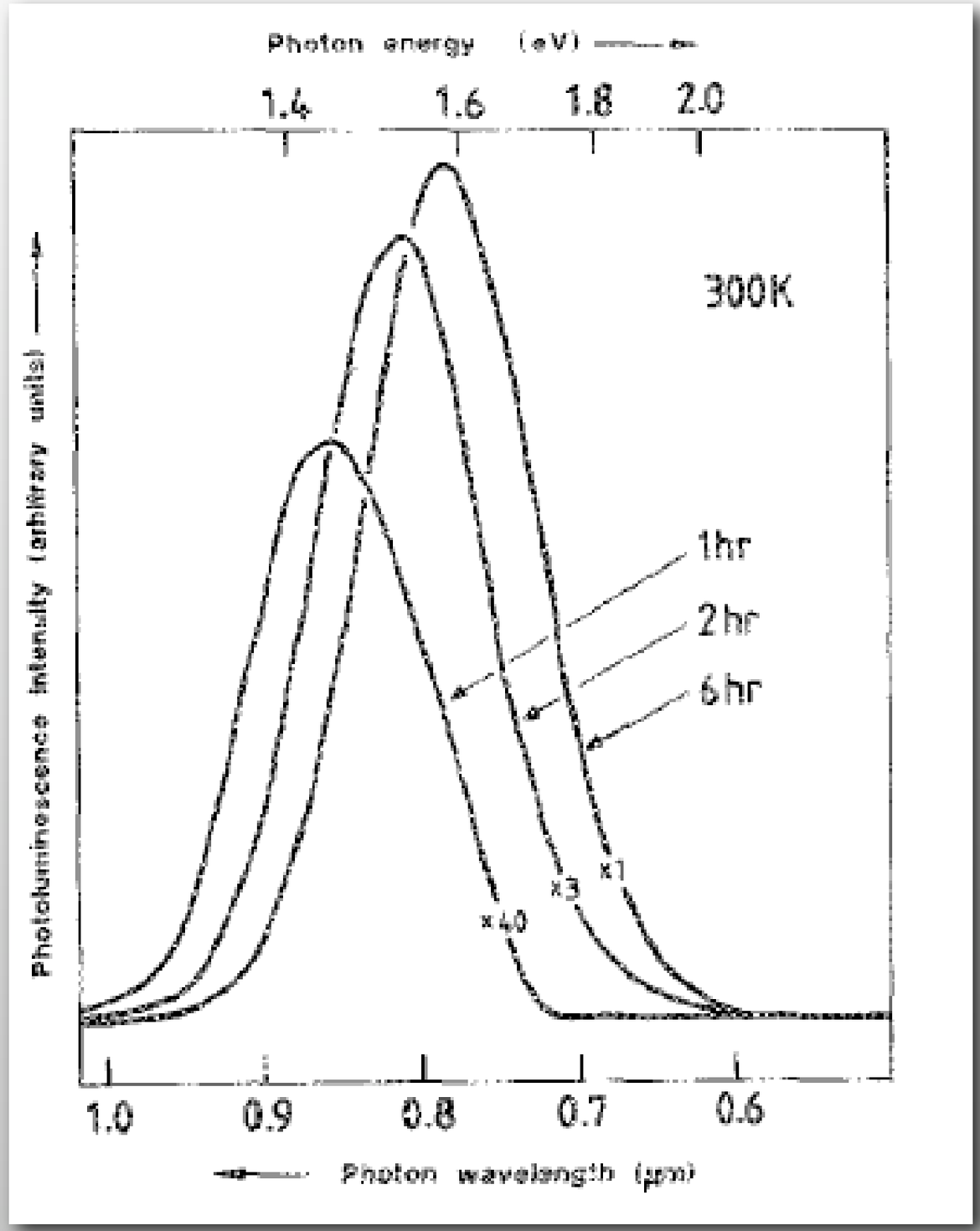

Silicon at various stages of electrochemical etching.

Exposure to HF for different periods of time increases luminescence.

Does luminescence arise from quantum confinement ? What does the surface look like ?

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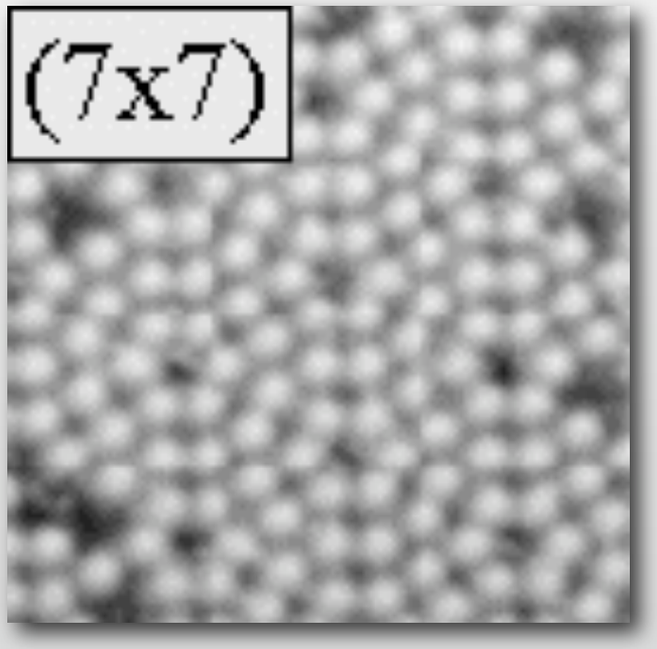
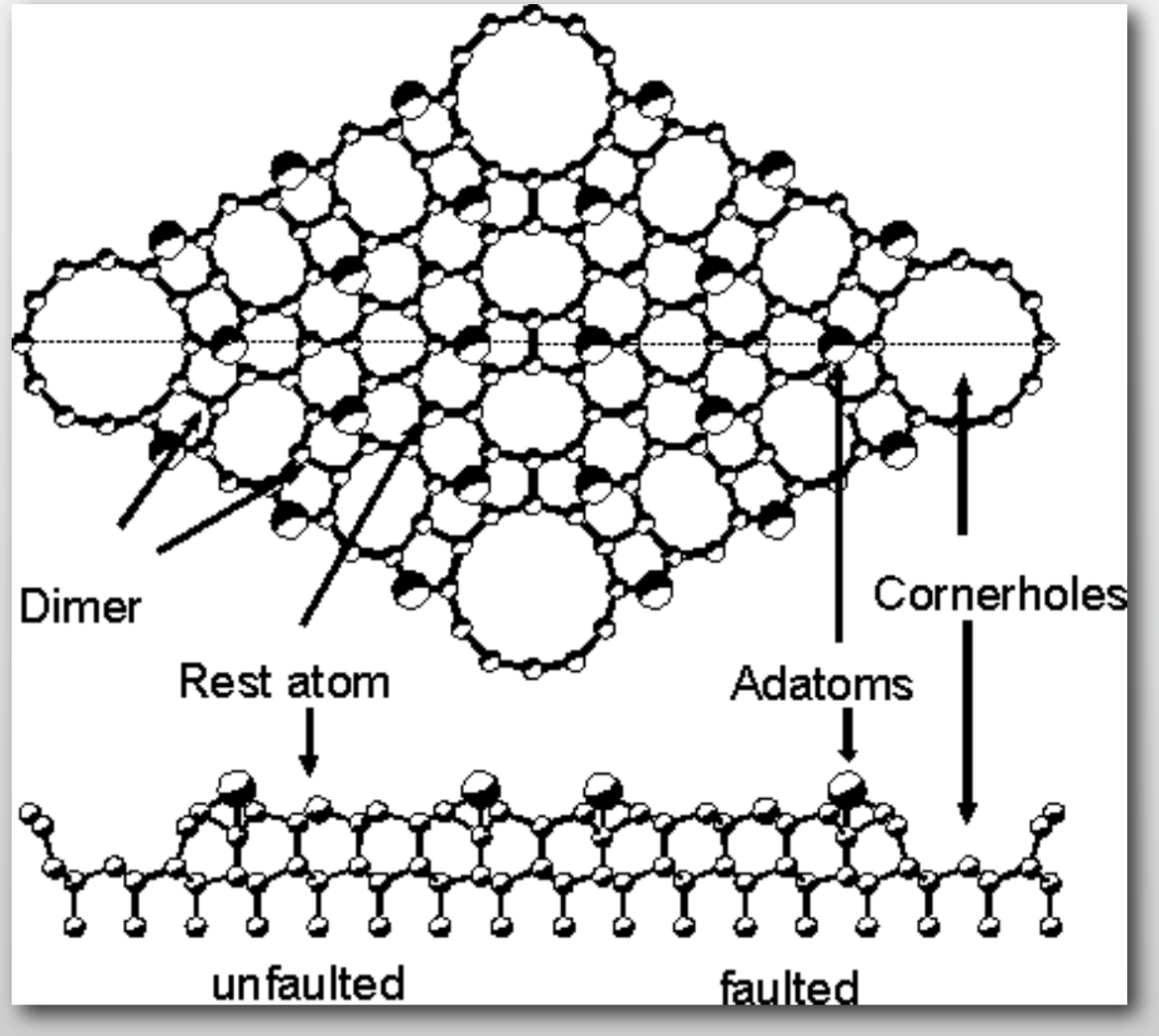
http://www.fkf.mpg.de/ga/research/stmtutor/stmex.html





The Si surface gets rid of dangling bonds through reconstruction, such as the famous 7x7 pattern.

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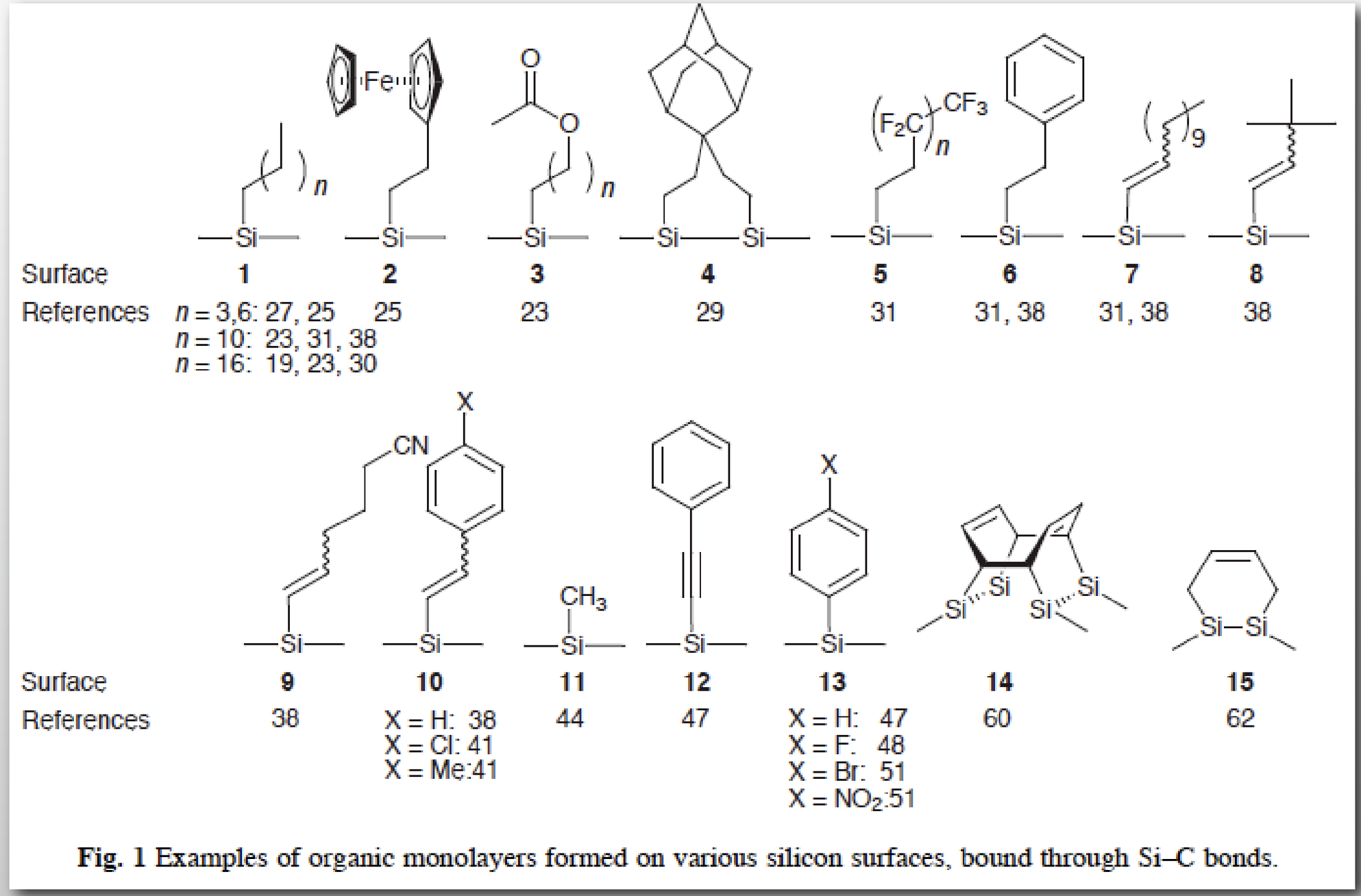

Fig. 1 Examples of organic monolayers formed on various silicon surfaces, bound through Si–C bonds.

Crucial chemistry for stabilizing Si surfaces. Reproducible results from porous Si cannot be expected unless the surface is well-understood.

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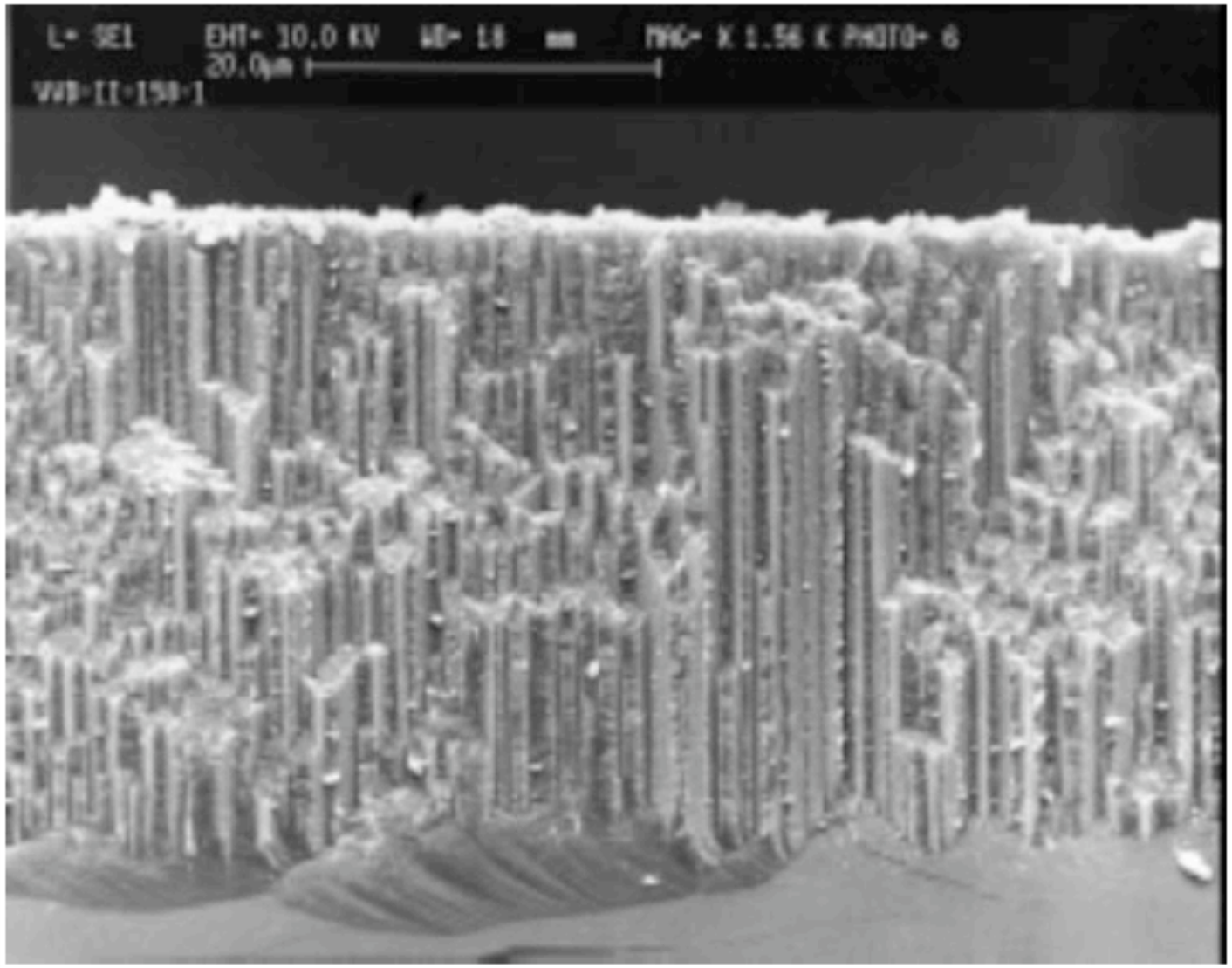

Fig. 2 Cross-sectional scanning electron micrograph (SEM) of a 30 μm thick porous silicon layer electrochemically etched on a (100) single-crystal wafer. The pores here are on the order of μm but through variation of the etching conditions, a wide range of pore sizes (from 2 nm to μm) is easily accessed. Professor M. J. Sailor is thanked for his kind permission to use this figure from ref. 2. Reproduced with permission from Wiley-VCH.

Electrochemically etched Si crystal. Note the pores are crystallographically aligned.

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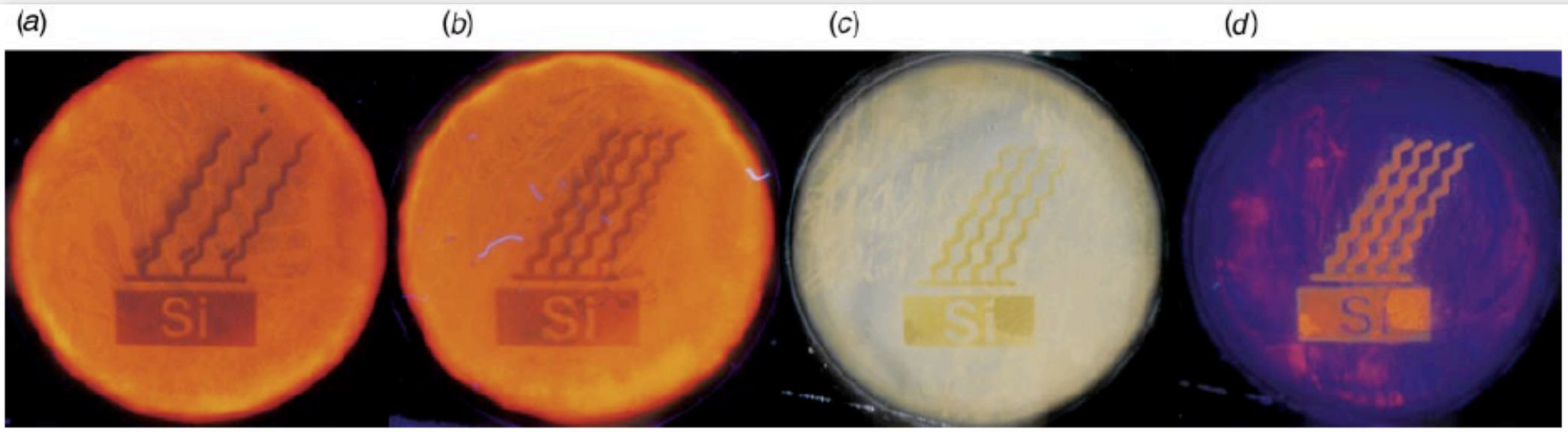

Fig. 6 Photographs of 12 mm diameter photoluminescent porous silicon samples prepared through white light promoted hydrosilylation of dodec-1-yne (surface **7**) and dodec-1-ene (surface **1**) through masking procedures.[31] (a) Surface **7** appears as the darkened, red-shifted patterned area when illuminated with a 365 nm hand-held UV lamp. The other areas of the wafer are unfunctionalized (native Si–H termination). (b) Surface **1** (ref-shifted patterned area) upon illumination with 365 nm light. (c) Sample from (b) after boiling in aerated, aqueous KOH (pH 12) solution for 15 s. The unfunctionalized porous silicon (grey area) has dissolved while the hydrosilylated surface (surface **1**, golden area) remains intact. (d) Illumination of the surface from (c) with a 365 nm hand held UV lamp. The PL of the hydrosilylated area (surface **1**) remains intact while most of the unfunctionalized PL is destroyed. This figure has been reproduced from ref. 31 with permission from Wiley-VCH.

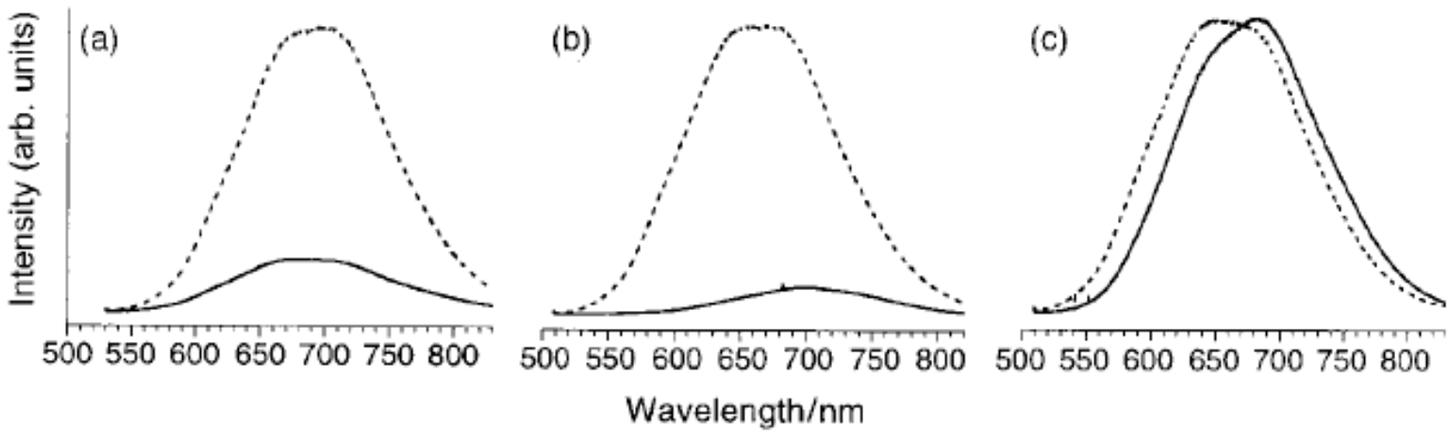

Fig. 7 Photoluminescence spectra of 1-dodecene hydrosilylation (surface **1**) on n-type porous silicon (440 nm excitation). The dotted spectrum is that of freshly etched porous silicon, and the solid that of the resulting dodecyl terminated surface. (a) Lewis acid mediated,[38] (b) thermally induced (2 h reflux in neat dodec-1-ene),[36] (c) white light promoted (60 min reaction at 22 mW cm^{-2} white light).[31]