CORNING

Quantum Technology at Corning

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DMMI Workshop
March 19, 2019

Corning Incorporated

Advanced materials covering a wide range of industries…

Display

Telecommunications

Aerospace & Defense

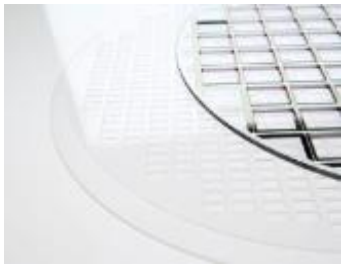
Ophthalmic & Industrial

Consumer Electronics

…and technologies

Precision Optics

Fiber Optics

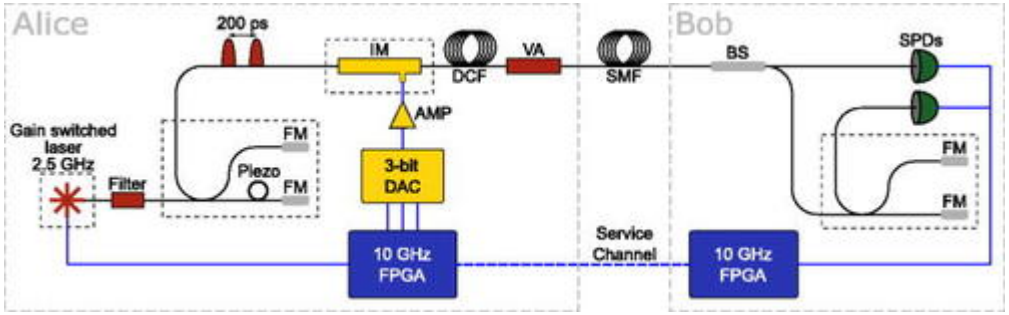


Precision Metrology

Laser Processing

Semiconductor Materials

Advanced optical materials play a critical role in quantum networks



Boaron, APL 112:171108 (2018)

- Ultra-low loss fiber
- Low dispersion
- Polarization control
- Dispersion compensation
- …

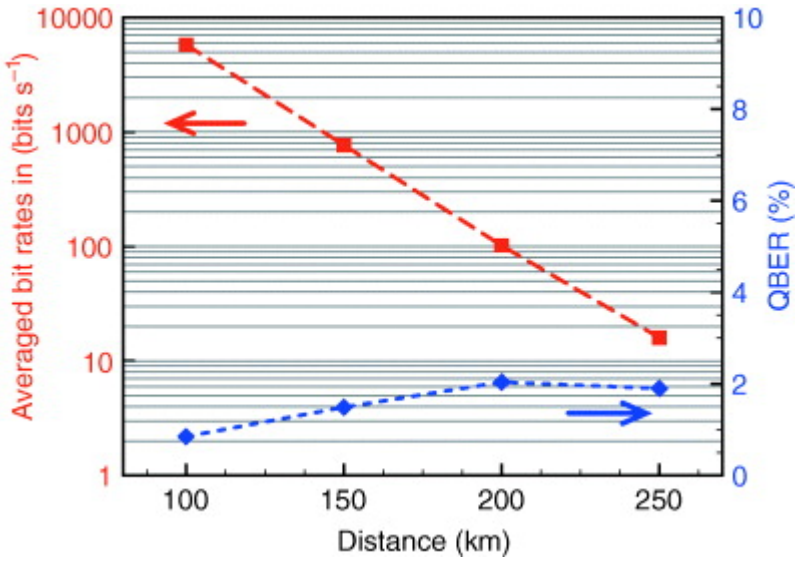
Transmission

- Transparent ceramic host
- Waveguides
- …

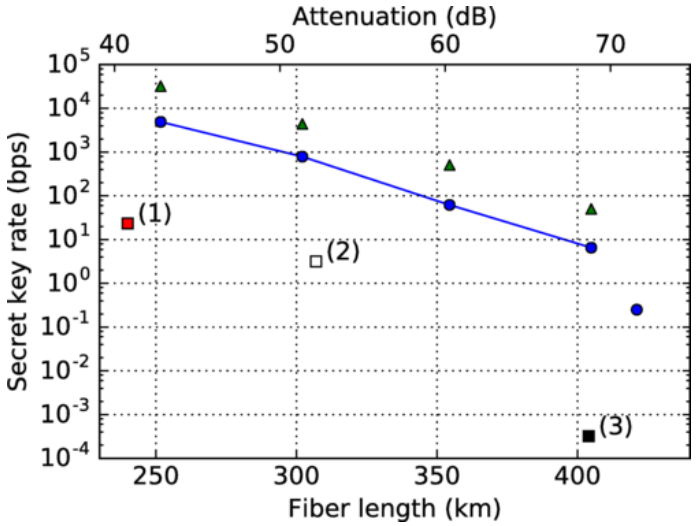
Quantum Memory

Dispersion compensating and low loss fibers enable long distance quantum key distribution

- 2009: 250 km QKD at 15 bps
- 2018: 250 km QKD at >12000 bps (maximum transmission of 421 km)



Stucki et al., New J. Phys. 11:075003 (2009)



Boaron et al., Phys. Rev. Lett. 121:190502 (2018)

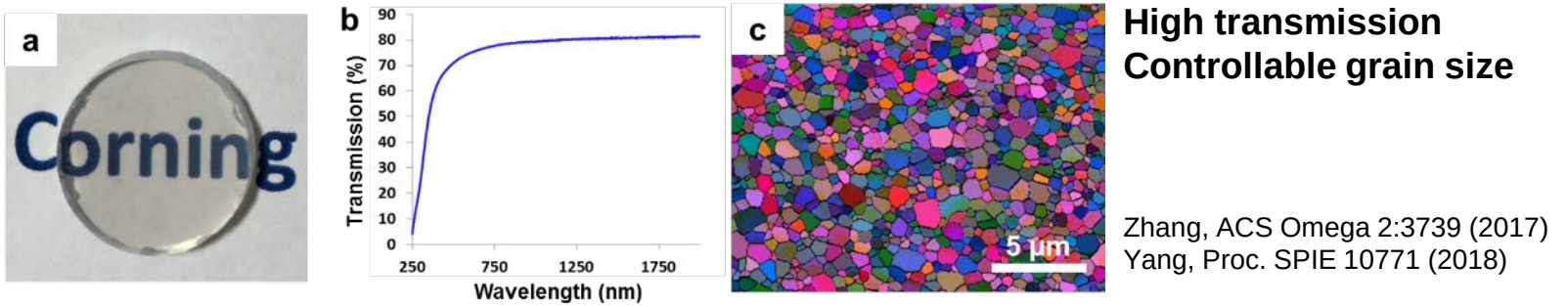
Quantum memory materials: transparent ceramics

Rare earth doped solids

- Well isolated 4f electrons → long coherence lifetime
- Solid state materials → easier processing and system integration
- Ensemble based storage → higher efficiency

Transparent ceramics (Er^{3+}:Y_2O_3)

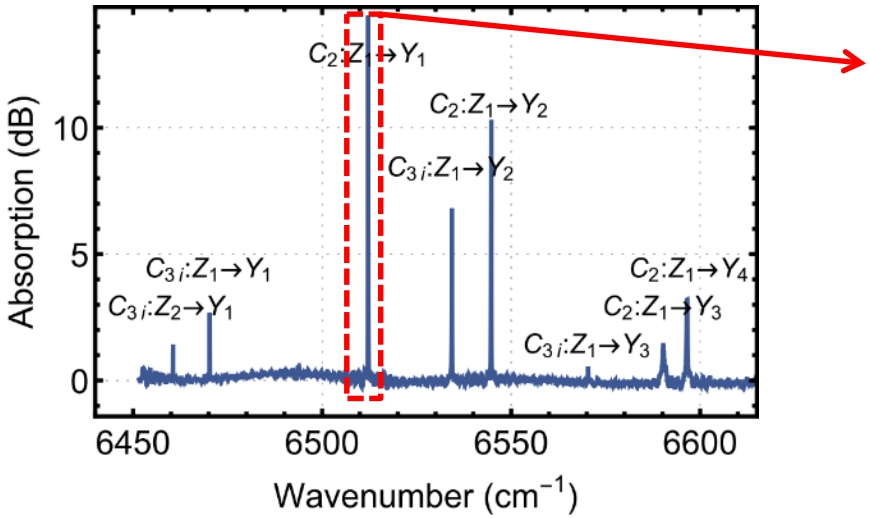
- Compatible with telecom wavelengths, existing infrastructure
- Proven material for good coherence properties
- Cubic crystal structure to minimize scattering due to polycrystalline phase

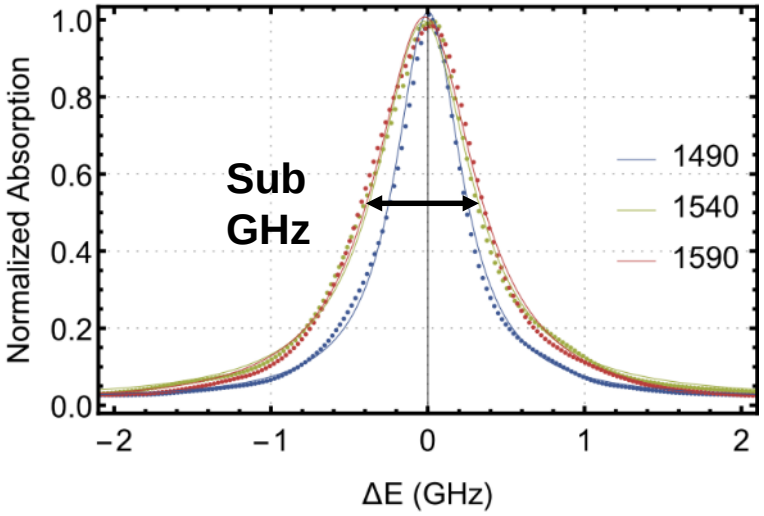


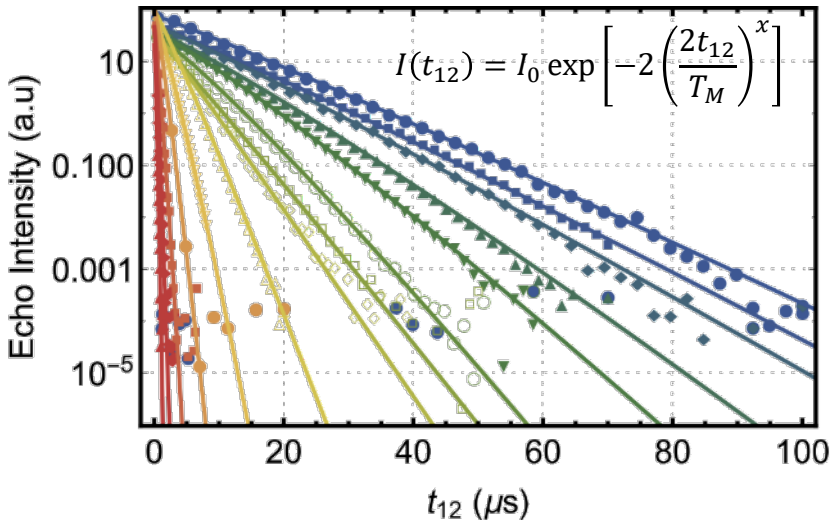
High transmission
Controllable grain size

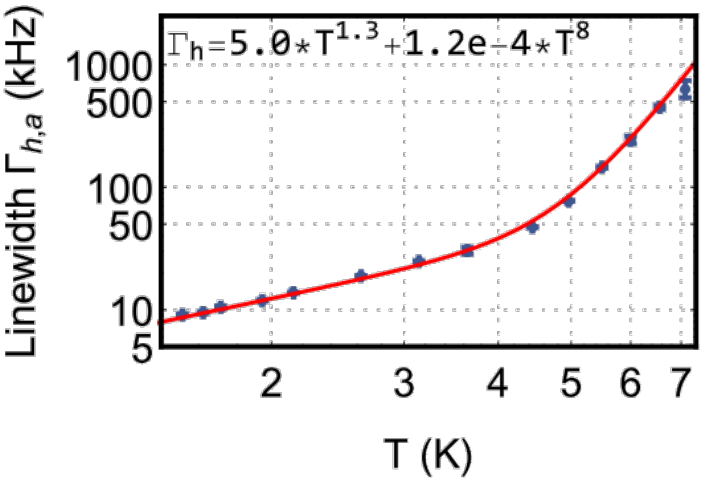
Zhang, ACS Omega 2:3739 (2017)
Yang, Proc. SPIE 10771 (2018)

Optimization of composition and processing resulted in high coherence lifetime



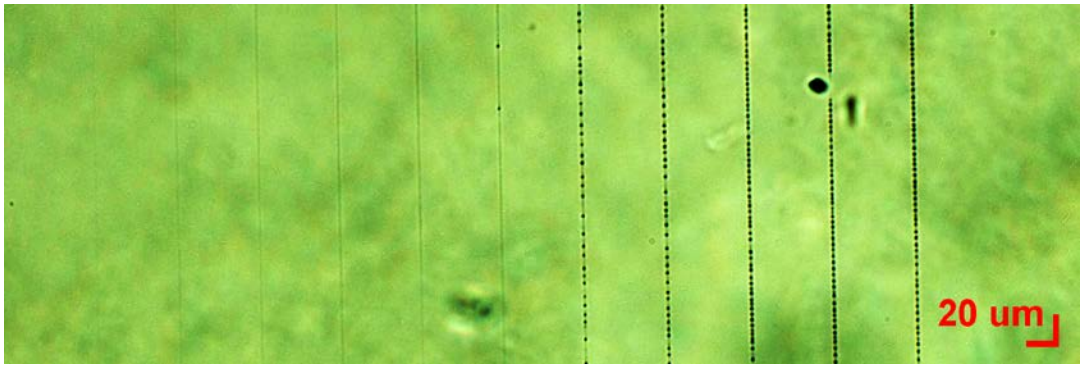




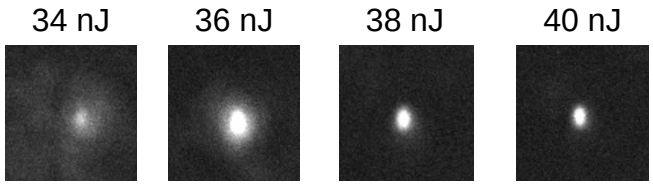


Zhang, ACS Omega 2:3739 (2017)
Yang, Proc. SPIE 10771 (2018)

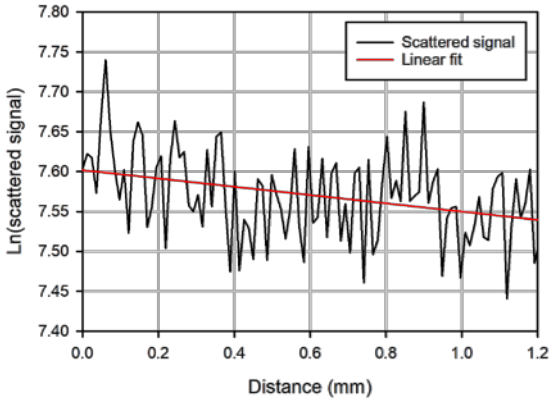
Femtosecond lasers enable waveguide writing in quantum memory materials



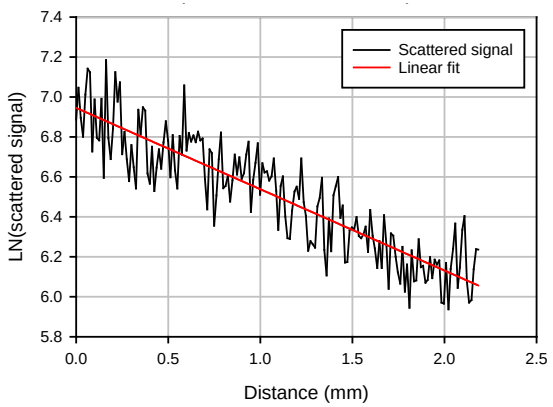
- Wavelength: 1030 nm
- Pulse width: 300 fs
- Rep rate: 20 kHz
- 50x objective focused 200 um below surface
- Scan speed 50 um/sec



Type I waveguide ($n_{core}>n_{cladding}$)



Type II waveguide ($n_{core}<n_{cladding}$)



Yang, Proc. SPIE 10771 (2018)

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