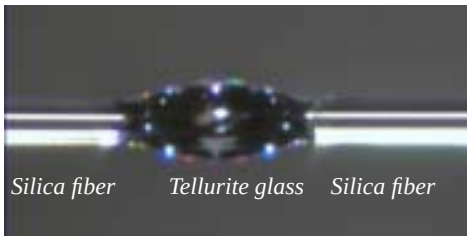
Low loss optical coupling structure between two ends of silica glass optical fibers by inserting TeO_2 melt

S. Todoroki and S. Inoue Advanced Materials Laboratory / NIMS Japan

Contents



$\ell \sim 0.5\,\mathrm{mm} \longrightarrow v \sim 0.007\,\mathrm{mm}^3 = 7\,\mathrm{n}\ell$

Conclusions

Background
Expected to add an active function into passive waveguide

Fabrication
Can join silica fibers regardless of poor thermal stability

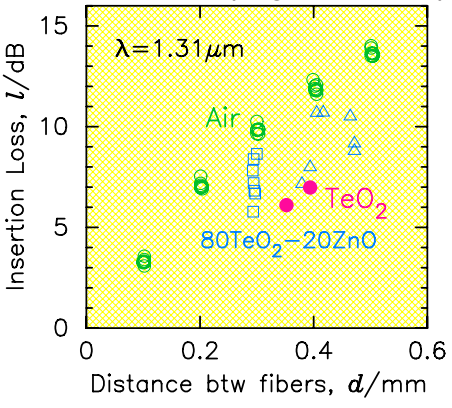
Insertion loss
> 7.5 dB $\Longrightarrow$ $<$ ***1.5 dB*** *with TEC fibers,* $\ell \sim 0.5$*mm*

Background — Answer to the 1st Q.↑

- Connecting to optical waveguides is **the last one step** for practical use.
- Soft glasses exhibit attractive properties, but it's hard to make **good waveguide.**
- This **can be solved** by this method to make "Hetero-junction" in glass.

Background — *What's already done?*

Insertion loss with SMF (single mode fiber)



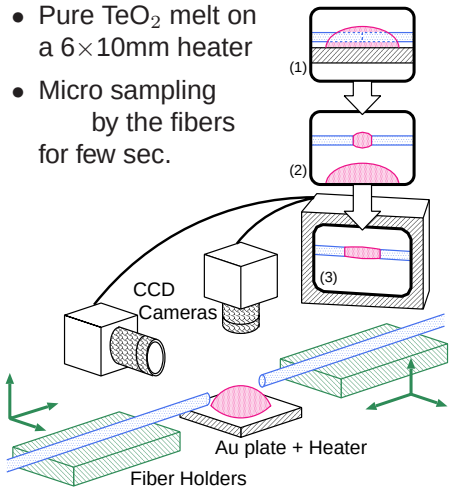
- Large loss value
  ∵ Lack of waveguide structure[1,2]

FYI — Tellurite glass as active device

- Realized devices:
  - Acousto-optics device (as bulk)
  - Er-doped fiber amp. (as host)
  - Raman fiber amp.
- Expected:
  - Non-linear optics
  - high-refractive-index host for micro-cavities

Fabrication — Apparatus

- Pure TeO_2 melt on a 6×10mm heater
- Micro sampling by the fibers for few sec.



Fabrication — *Is it precipitates-free?*

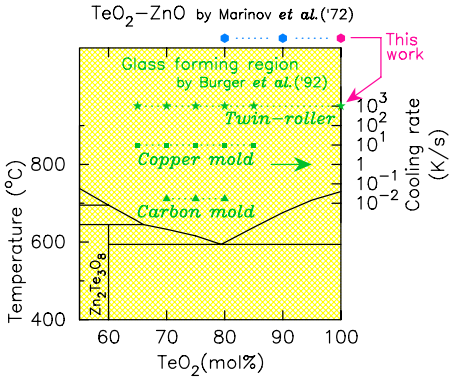
Not yet checked by XRD, but...

✔ ✔ same as $80TeO_2$–$20ZnO$

✔ the bending test

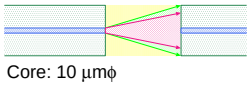
$\Longrightarrow$ **No harmful precipitates** for optical applications [2]

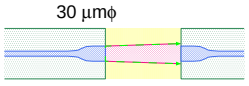
Fabrication — Cooling rate is very high



Fabrication — Here we used TEC Fibers

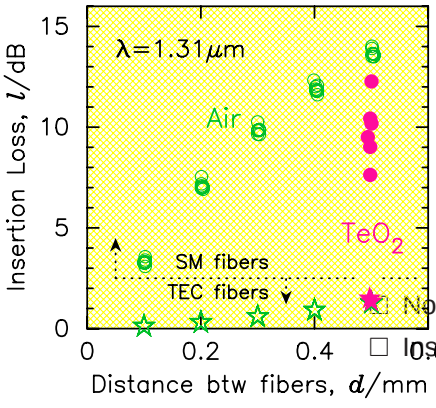
- SM (single mode)





- TEC (Thermal-diffusion Expanded Core)

Insertion loss — Loss: SM vs. TEC



Fresnel Reflection	0.35 dB
Coupling Loss + ...	∼ 1 dB
Total: ★	1.33 dB

Advantages — TeO_2 into silica fibers

- single component glass
- non-hygroscopic
- short melting time prevents volatilization problems

Another conclusion

Now we achieved ***FTTG*** *(Fiber To The Glass).*
Let's make the glass ***something active!***

[1] S. Todoroki, A. Nukui, and S. Inoue, *J. Ceram. Soc. Jpn.*, vol. 110, no. 5, pp. 476–478, 2002.
[2] S. Todoroki, A. Nukui, and S. Inoue, *SPIE Proceedings*, vol. 5061, pp. 50–58, 2003.
[3] S. Todoroki and S. Inoue, *J. Non-Cryst. Solids*, vol. 328, pp. 237–240, 2003.

Typeset by LaTeX2e