

Preparation of glass fibers with a Ce³⁺:YAG glass ceramic core

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ABSTRACT

Glass fibers with Ce³⁺:YAG glass ceramic core were produced. I860 glass tubes were used as preforms. Two different glasses were tested as core material: I860 and SF57. In order to fill the preforms with glass and Ce³⁺:YAG, the core glass was powdered, sieved to grain sizes <32 μm, mixed with the Ce³⁺:YAG powder and pressed to cylinders which were filled into the glass preform. Glass fibers of 125 μm diameter were drawn at temperatures between 730 °C and 760 °C.

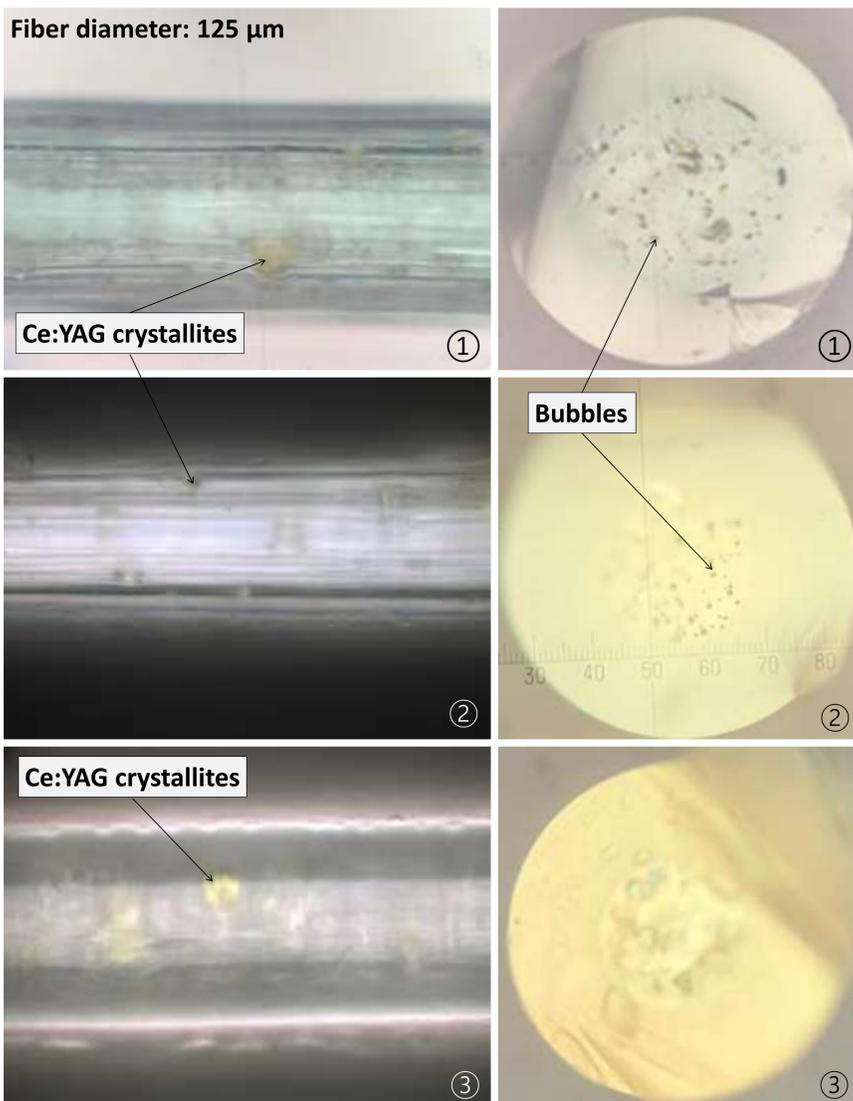
MOTIVATION

- ✓ white light generation in a glass fiber by coupling blue laser light into the fiber and using Ce³⁺:YAG crystallites to convert blue to broad-band yellowish white light
- ✓ miniaturized, flexible white light source
- ✓ possible application in white light interferometry or as optical sensor

RESULTS: MICROSTRUCTURE

Side view

Cross section



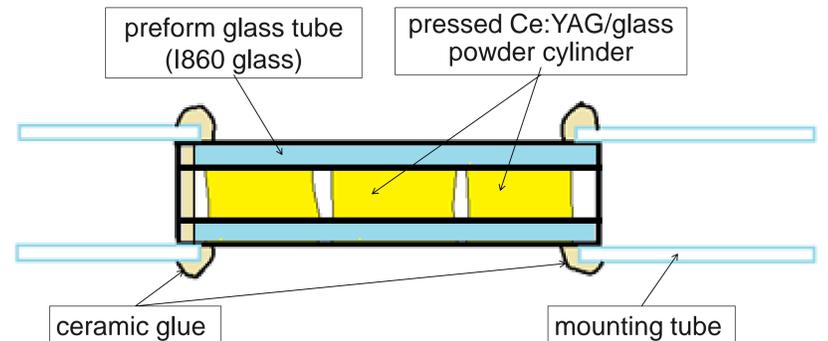
- ① I860 + Ce:YAG powders compressed manually;
- ② I860 + Ce:YAG powders compressed with hydraulic press
- ③ SF57 + Ce:YAG powders compressed with hydraulic press

SUMMARY

- ✓ Fiber drawing possible with I860 and SF57 core glasses
- ✓ No chemical reaction between core glasses (I860/SF57) and Ce³⁺:YAG crystallites
- ✓ With SF57 core glass probably no bubbles
- ✓ White light generation possible, but insufficient white light guiding: high losses because of stray light and 4π emission

EXPERIMENTAL

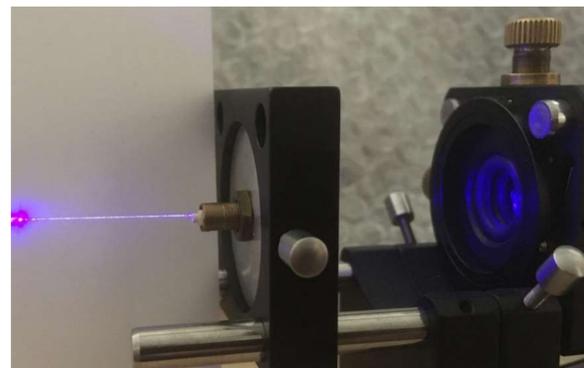
- ✓ Fiber core options: SF57 (lead silicate glass) / I860 (soda lime silicate glass) + 2 ma% Ce³⁺:YAG
- ✓ Fiber core glasses and Ce³⁺:YAG powdered <32 μm, mixed, pressed to cylinders
- ✓ Preform preparation
- ✓ Fiber drawing: 730-760 °C



RESULTS: FIBER AND DRAWING ONION

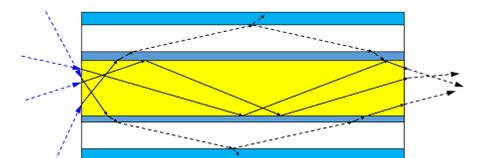
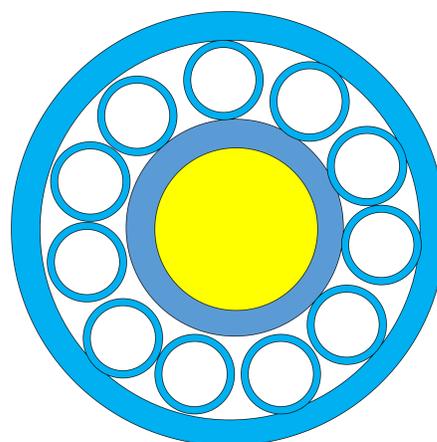


RESULTS: BLUE LASER TEST



- ✓ Blue laser coupling possible
- ✓ White light generation observed
- ✓ White light guiding not sufficient
- low white light intensity

OUTLOOK



- New fiber geometry
- different core glasses (higher n)
- Increased refractive index difference core/cladding
- Higher Ce³⁺:YAG concentration
- Higher white light intensity