FIG. 1

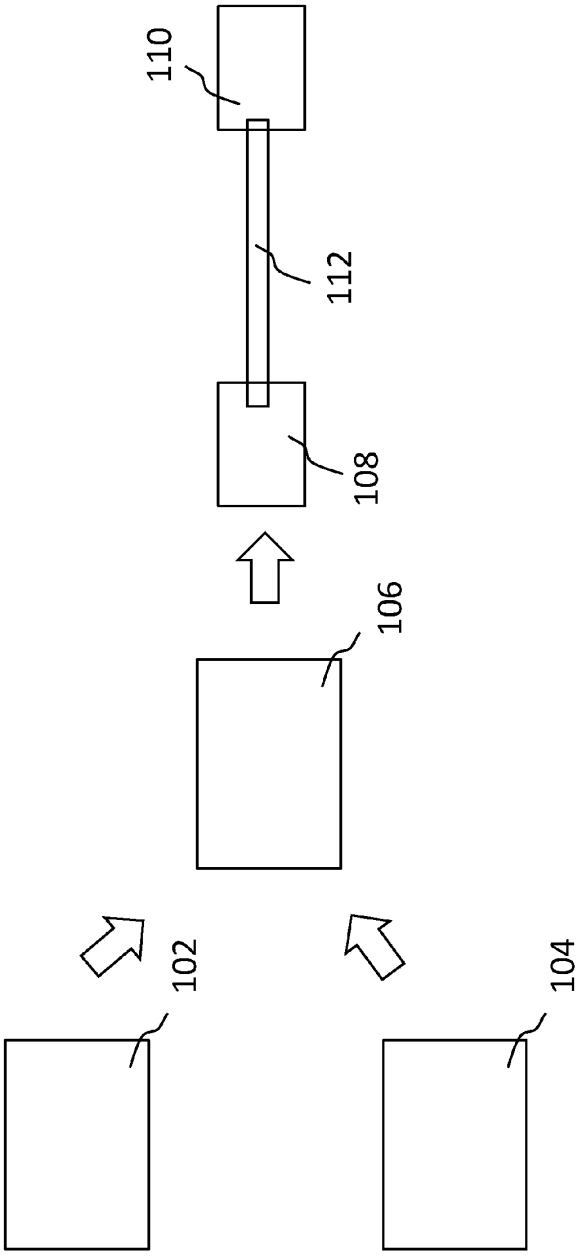


FIG. 2

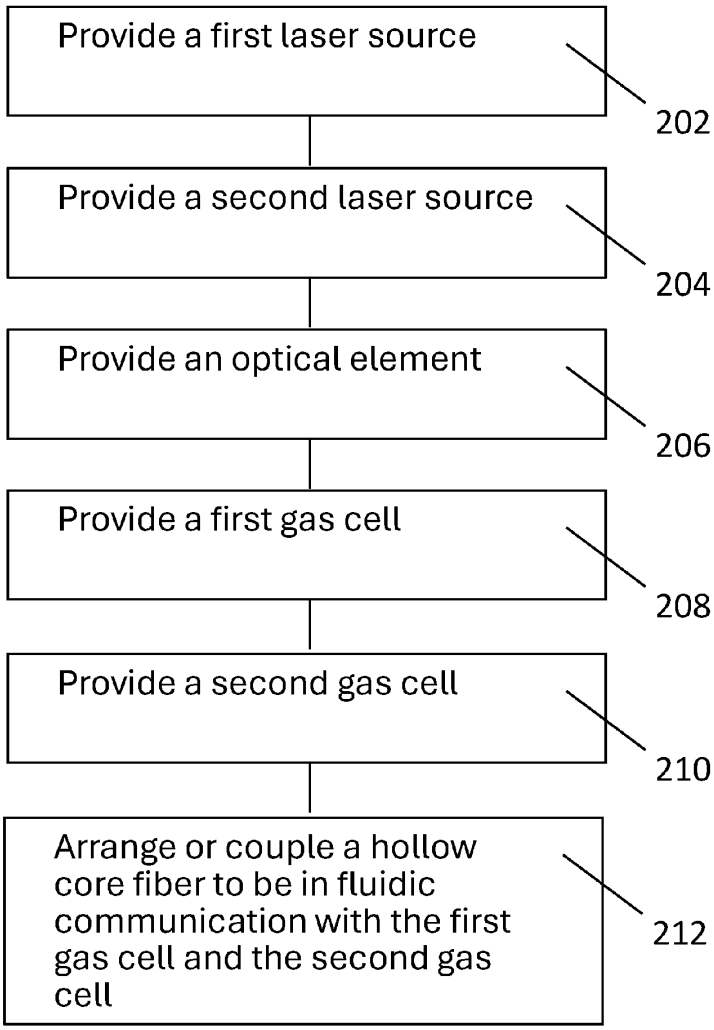

Provide a first laser source
202
Provide a second laser source
204
Provide an optical element
206
Provide a first gas cell
208
Provide a second gas cell
210
Arrange or couple a hollow core fiber to be in fluidic communication with the first gas cell and the second gas cell
212

FIG. 3

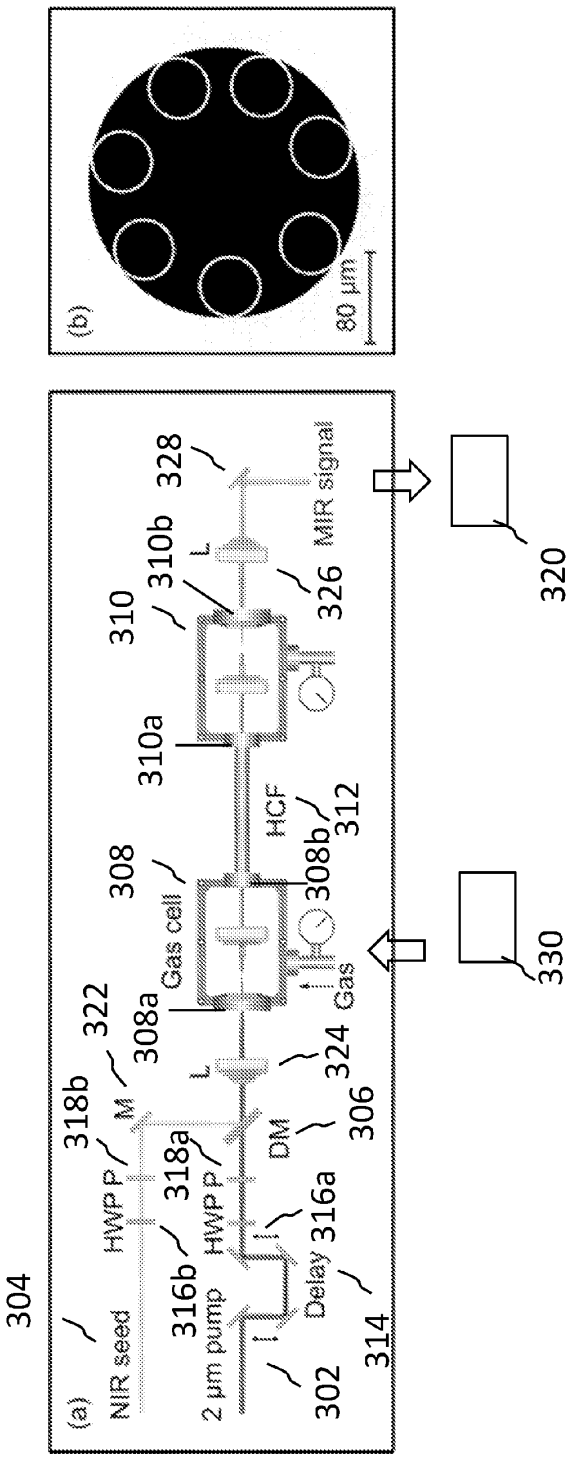

(b)
80 µm
(a)
NIR seed
2 µm pump
HWP
HWP
Delay
M
DM
L
Gas cell
Gas
HCF
L
MIR signal
304
302
314
316a
316b
318a
318b
322
308a
324
306
308
308b
312
310a
310
310b
326
328
320
330

FIG. 4A

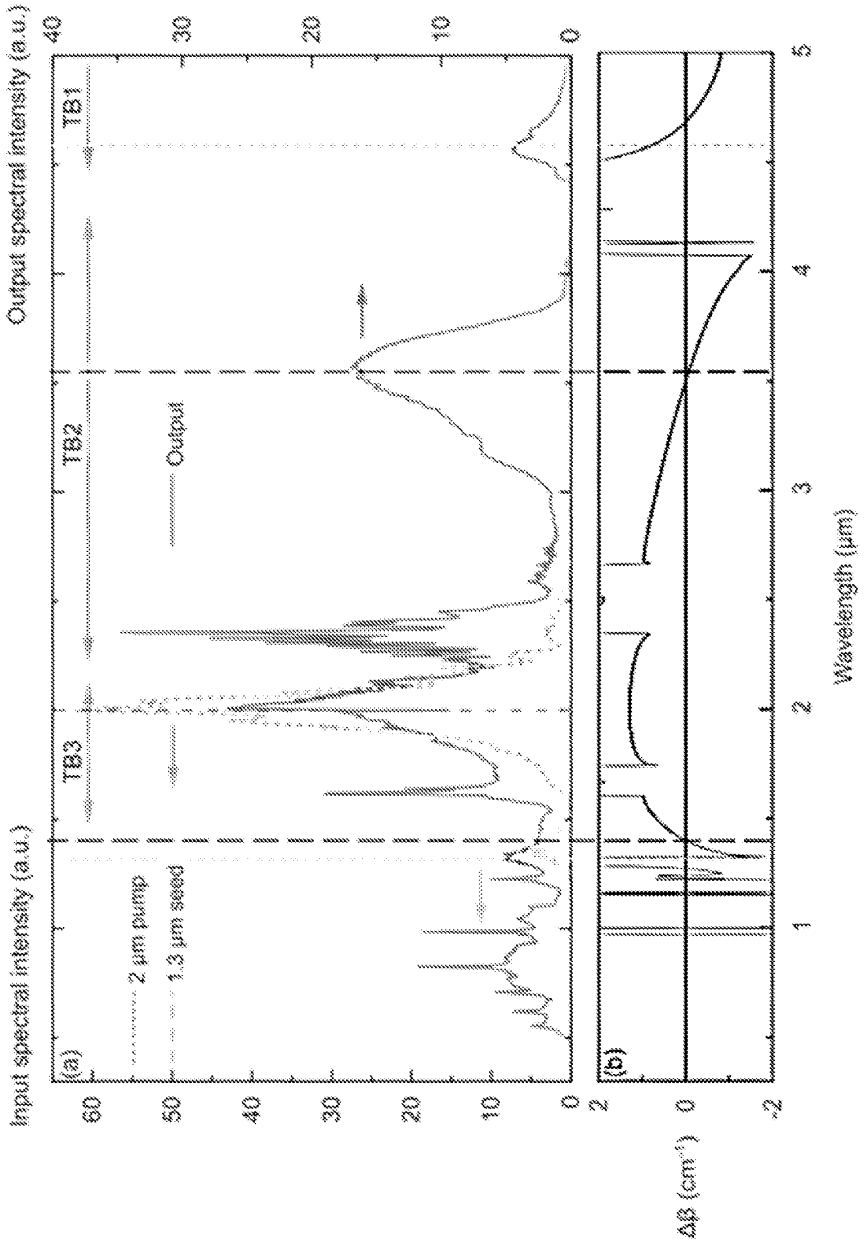

Input spectral intensity (a.u.)
Output spectral intensity (a.u.)
TB3
TB2
TB1
2 μm pump
1.3 μm seed
Output
(a)
(b)
Δβ (cm⁻¹)
Wavelength (μm)

FIG. 4B

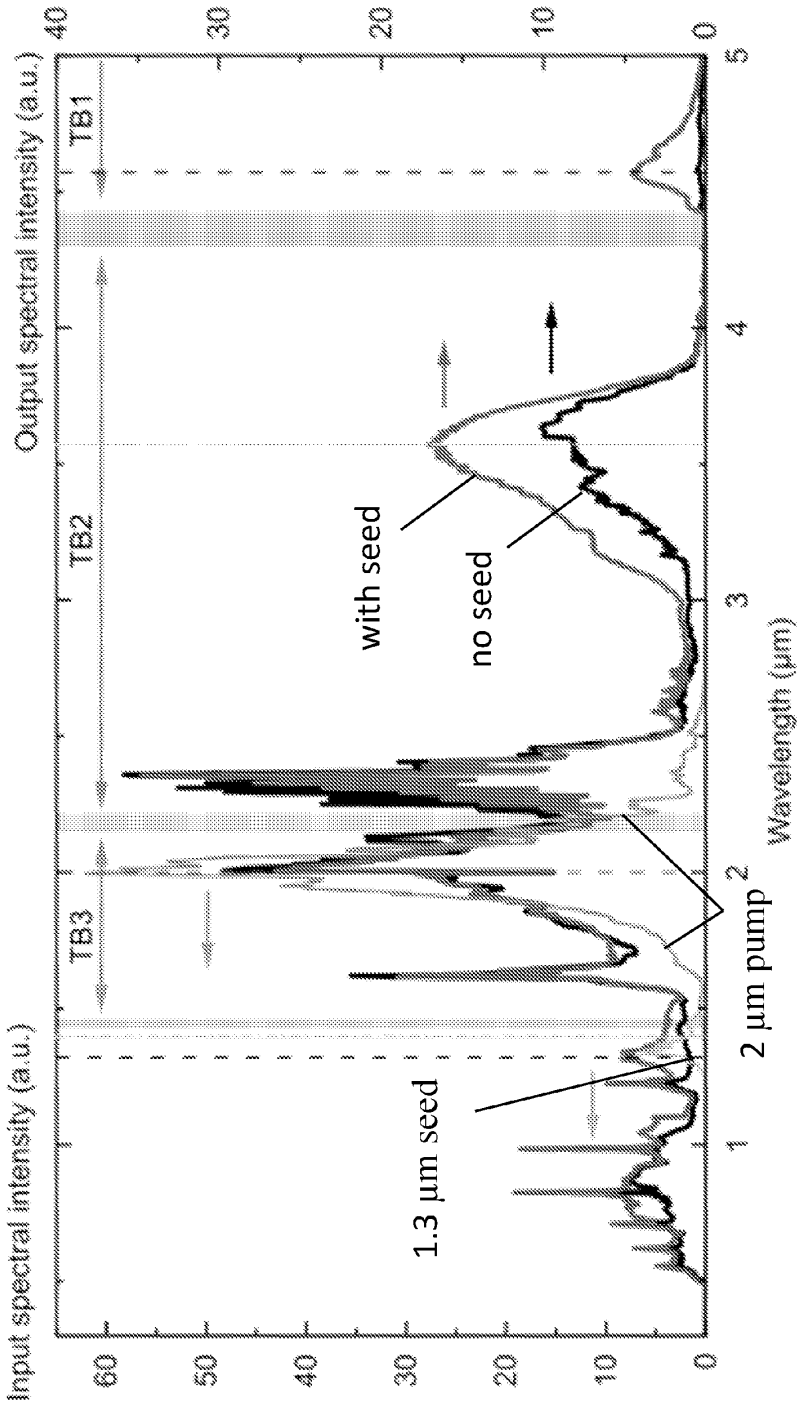

Input spectral intensity (a.u.)
Output spectral intensity (a.u.)
Wavelength (μm)
TB1
TB2
TB3
1.3 μm seed
2 μm pump
with seed
no seed

FIG. 5

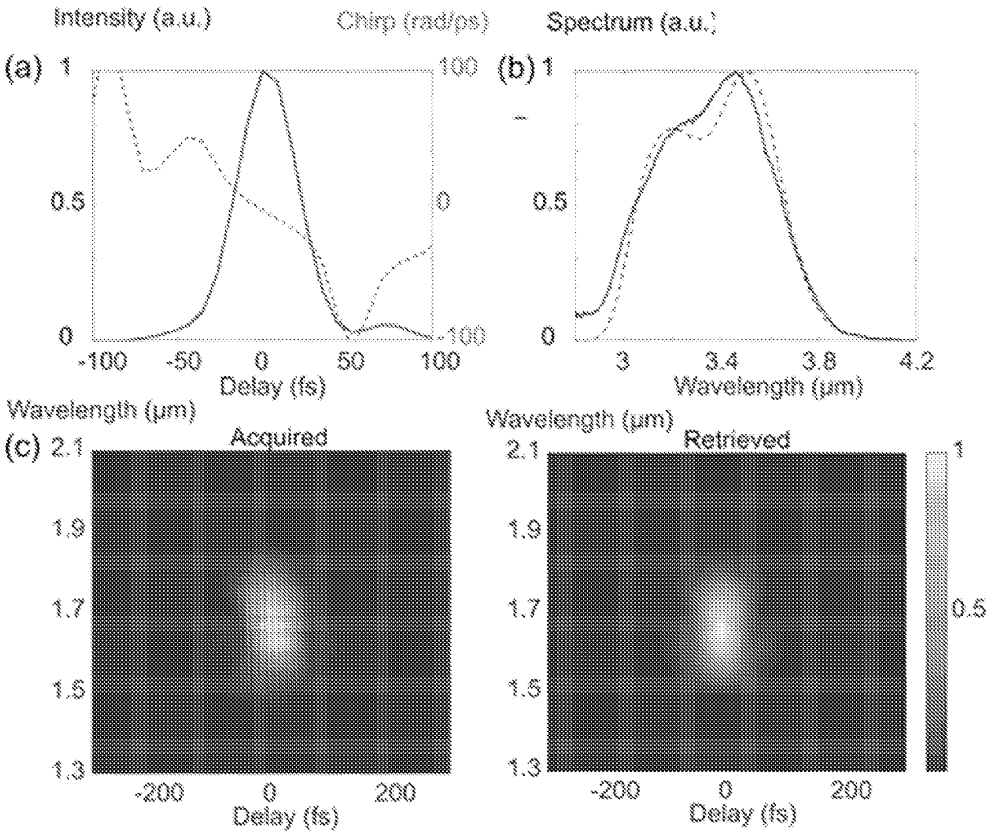

Intensity (a.u.)
Chirp (rad/ps)
(a)
1
0.5
0
100
0
-100
-100
-50
0
50
100
Delay (fs)
Spectrum (a.u.)
(b)
1
0.5
0
3
3.4
3.8
4.2
Wavelength (μm)
Wavelength (μm)
(c)
Acquired
2.1
1.9
1.7
1.5
1.3
-200
0
200
Delay (fs)
Wavelength (μm)
Retrieved
2.1
1.9
1.7
1.5
1.3
-200
0
200
Delay (fs)
1
0.5

FIG. 6

