



US010205295B2

(12) **United States Patent**
Volodin et al.

(10) **Patent No.:** **US 10,205,295 B2**
(45) **Date of Patent:** ***Feb. 12, 2019**

(54) **CHIRPED BRAGG GRATING ELEMENTS**

(71) Applicant: **NECSEL INTELLECTUAL PROPERTY, INC.**, Pennington, NJ (US)

(72) Inventors: **Boris Leonidovich Volodin**, Pennington, NJ (US); **Vladimir Sinisa Ban**, Princeton, NJ (US)

(73) Assignee: **NECSEL INTELLECTUAL PROPERTY, INC.**, Pennington, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **15/702,946**

(22) Filed: **Sep. 13, 2017**

(65) **Prior Publication Data**
US 2018/0013255 A1 Jan. 11, 2018

Related U.S. Application Data

(60) Continuation of application No. 13/629,899, filed on Sep. 28, 2012, now Pat. No. 9,793,674, which is a (Continued)

(51) **Int. Cl.**
H01S 3/08 (2006.01)
H01S 3/00 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H01S 3/0057** (2013.01); **G02B 19/0014** (2013.01); **G02B 19/0057** (2013.01);
(Continued)

(58) **Field of Classification Search**

CPC H01S 3/08009; H01S 3/0057; H01S 3/08031; H01S 3/109; H01S 3/08013
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,145,252 A 8/1964 Herriott
3,396,343 A 8/1968 Wesselink
(Continued)

FOREIGN PATENT DOCUMENTS

EP 0310438 A1 4/1989
EP 0322218 A2 6/1989
(Continued)

OTHER PUBLICATIONS

U.S. Appl. No. 10/390,521, filed Jul. 3, 2003, Volodin, et al.
(Continued)

Primary Examiner — Kinam Park

(74) *Attorney, Agent, or Firm* — Condo Roccia Koptiw LLP

(57) **ABSTRACT**

Apparatus and methods for altering one or more spectral, spatial, or temporal characteristics of a light-emitting device are disclosed. Generally, such apparatus may include a volume Bragg grating (VBG) element that receives input light generated by a light-emitting device, conditions one or more characteristics of the input light, and causes the light-emitting device to generate light having the one or more characteristics of the conditioned light.

20 Claims, 29 Drawing Sheets

