



(12) **United States Patent**
Czettel

(10) **Patent No.:** **US 9,409,784 B2**
(45) **Date of Patent:** **Aug. 9, 2016**

(54) **METHOD FOR PRODUCING A HARD MATERIAL LAYER ON A SUBSTRATE, HARD MATERIAL LAYER AND CUTTING TOOL**

428/702, 704; 427/255, 255.28, 255.36, 427/255.391

See application file for complete search history.

(71) Applicant: **CERATIZIT AUSTRIA GESELLSCHAFT MBH**, Reutte (AT)

(56) **References Cited**

(72) Inventor: **Christoph Czettel**, Poels (AT)

U.S. PATENT DOCUMENTS

(73) Assignee: **Ceratizit Austria GmbH**, Reutte (AT)

4,746,563 A * 5/1988 Nakano C23C 30/005 427/255.34

4,895,770 A 1/1990 Schintlmeister et al.

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

(Continued)

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **14/381,275**

AT 008346 U1 6/2006
DE 4343354 A1 6/1995

(Continued)

(22) PCT Filed: **Feb. 25, 2013**

OTHER PUBLICATIONS

(86) PCT No.: **PCT/AT2013/000034**

§ 371 (c)(1),

(2) Date: **Aug. 27, 2014**

Holzschuh H: "Chemical-vapor deposition of wear resistant hard coatings in the Ti—B—C—N system: properties and metal-cutting tests", International Journal of Refractory Metals and Hard Materials, Elsevier Publishers, Barking, GB, vol. 20, No. 2, Mar. 1, 2002, pp. 143-149, XP004382026, ISSN: 0263-4368, DOI: 10.1016/S0263-4368(02)00013-6.

(Continued)

(87) PCT Pub. No.: **WO2013/126935**

PCT Pub. Date: **Sep. 6, 2013**

Primary Examiner — Archene Turner

(74) Attorney, Agent, or Firm — Laurence A. Greenberg; Werner H. Stemer; Ralph E. Locher

(65) **Prior Publication Data**

US 2015/0099108 A1 Apr. 9, 2015

(30) **Foreign Application Priority Data**

Feb. 27, 2012 (AT) GM74/2012

(57) **ABSTRACT**

A process for producing a hard material layer on a substrate includes depositing a TiCNB hard material layer by chemical vapor deposition (CVD) from a gas system including a titanium source, a boron source, at least one nitrogen source and at least one carbon source, in which the carbon source includes an alkane having at least two carbon atoms, an alkene or an alkyne. A cutting tool includes a substrate to which a TiCNB hard material layer has been applied, in which a ratio of carbon atoms (C) to nitrogen atoms (N) in the TiC_xN_yB_{1-x-y} system deposited on the substrate is 0.70 ≤ X ≤ 1.0, preferably 0.75 ≤ X ≤ 0.85, and a polished section through the substrate and the hard material layer is substantially free of an eta phase following Murakami etching.

(51) **Int. Cl.**

C23C 16/30 (2006.01)

C01B 35/08 (2006.01)

(Continued)

(52) **U.S. Cl.**

CPC **C01B 35/08** (2013.01); **B22D 11/1206**

(2013.01); **B22D 11/1287** (2013.01);

(Continued)

(58) **Field of Classification Search**

USPC 51/307, 309; 428/697, 698, 699, 701,

23 Claims, 3 Drawing Sheets

