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SHAPING THE FUTURE WITH "TSUNAGU" TECHNOLOGY.

FUJIKURA NEWS

Power & Telecom

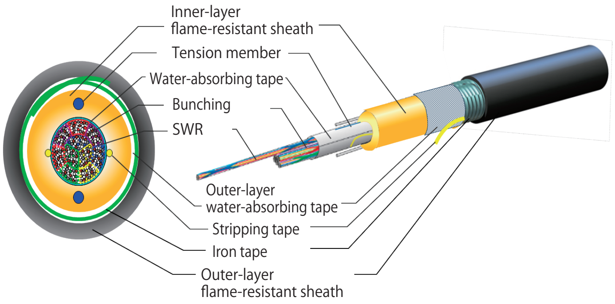
Sales Launch of CPR-compliant Sheathed Highly-flame-resistant Low-smoke WTC

Fujikura has launched the sales of high-flame resistance low-smoke Wrapping Tube Cable® (WTC®), which conforms to EU's Construction Products Regulation (CPR*1) and is CE-marked. These cables use our proprietary technology, 12-fiber ribbons called Spider Web Ribbon® (SWR®).

The WTC® that has just been released is suitable to be installed indoors and outdoors. Thus, the cable is characterized by weather resistance on its outer sheath, high flame resistance and low smoke emission to contain personal and physical damage at a minimum level in case of a fire inside a building. For indoor installation, in Europe, especially, there is the construction products regulation (CPR). The test items required by the regulation consist of flammability, smoke production, flammable droplet generation, and density of acid combustion gasses.

Fujikura's sheathed highly-flame-resistant low-smoke WTCs® have achieved the industry's highest requirement level of B2ca, s1a, d0, and a1*3 , as optical cables for general installation in buildings. The WTC®s are optical cables with an unprecedentedly small diameter and lightweight and can be installed in a limited space by using SWRs®. In addition, this product offers improved identifiability through SZ bunching and strip ring marking techniques, and a jelly-free completely dry structure, and 12-fiber lump-sum fusion splicing. These features are expected to allow significant reductions in installation time compared to conventional cables and thus contribute to building networks.

● Sheathed highly-flame-resistant low-smoke WTC® structure


Inner-layer flame-resistant sheath
Tension member
Water-absorbing tape
Bunching
SWR
Outer-layer water-absorbing tape
Stripping tape
Iron tape
Outer-layer flame-resistant sheath

● Specifications

Use	Indoors and outdoors
Fiber number	432
Fiber diameter	250 μm
External diameter	Approx. 22.0 mm
Weight	Approx. 560 kg/km
CPR grade	B2ca, s1a, d0, s1

*1 CPR stands for the Construction Products Regulation of the EU.
*2 CE marking guarantees that the product satisfies the standard of the EU countries.
*3 B2ca, s1a, d0, and a1 express the grades of CPR. B2ca: flammability, s1a: smoke production, d0: droplet generation, a1: acid density degree of combustion gasses

✉ Optical Cable Systems Division telcon@jp.fujikura.com

R&D

Development and Operation of Visual Inspection System Using AI (Deep Learning)

Fujikura has been studying AI (deep learning) since 2015. In 2017, the development of a visual inspection system started as the first step of putting AI (deep learning) to practical use in our production lines. Since 2018, the system has been operating automatically. The system inspects laser diode (LD) wafers, which are the key components of fiber lasers and manufactured by Optoenergy Inc., one of our group companies.

This system has been carrying out fully unmanned visual inspection stably for one year after its introduction. There are few cases of applying AI (deep learning) in the manufacturing industry, so they are attracting attention of academic societies and TV programs.

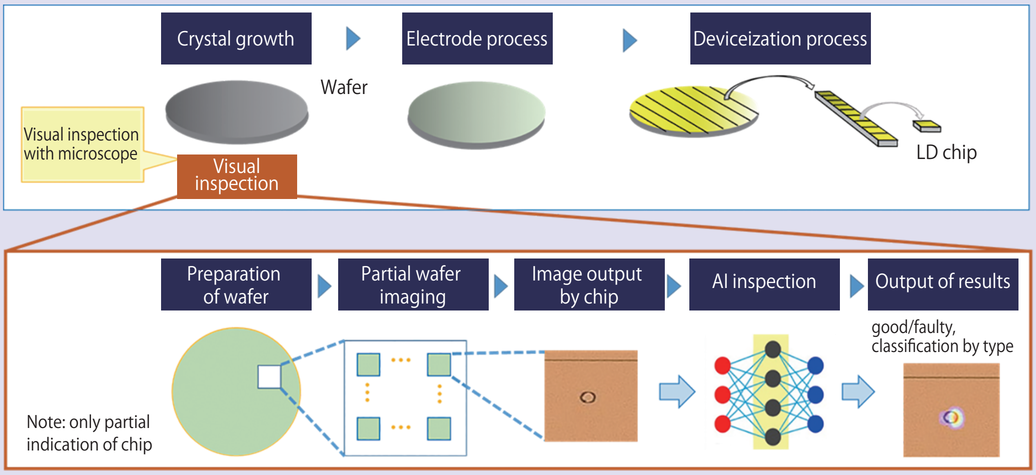
Outlook of visual inspection system using AI (deep learning)

In the past, in a process of growing crystals on wafers, wafers were checked for flaws and minute dust by human eyes using microscope. Finding micron-size abnormalities was a great burden to engineers, and the validation accuracy was about 95%.

In our visual inspection system using AI(deep learning), the entire image of a wafer is divided into chip units and each image is judged as passed or failed and classified by abnormality types. The areas that include abnormalities are indicated on a heat map.

● LD device production process

● Inspection system outline

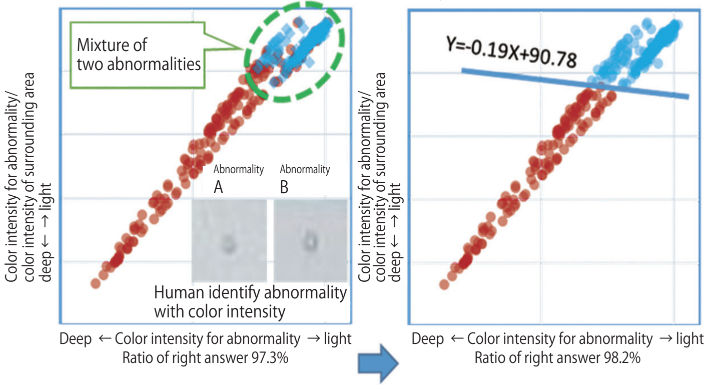

Crystal growth
Electrode process
Deviceization process
Wafer
LD chip
Visual inspection with microscope
Visual inspection
Preparation of wafer
Partial wafer imaging
Image output by chip
AI inspection
Output of results
good/faulty, classification by type
Note: only partial indication of chip

Efforts in improving validation accuracy

When AI (deep learning) learns, inconsistent validation results by an inspector will cause decrease in accuracy of validation made by the system. So, we used a machine learning method to let the system learn corrected human validation. This has resulted in an increase in validation accuracy by AI.

● Inconsistency by human in image learning

● Human inconsistency correction by machine learning



Ratio of right answer 97.3%

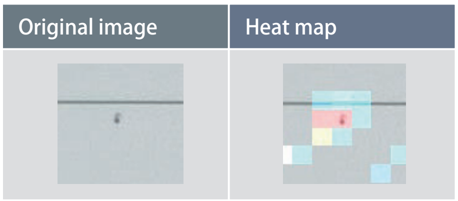
Ratio of right answer 98.2%

Efforts in making AI (deep learning) white box

Generally, there are challenges in validation by AI (deep learning) that the result is hard to be understood by humans because the reasons are unclear and a black box.

Fujikura has introduced a technology to make the result a white box by marking the area that AI (deep learning) took note on a heat map. This technology has enabled AI (deep learning) to be understood and installed in some of our production lines.

● Original image and heat map


Original image
Heat map

* Heat map: image colored in red, yellow, blue, clear in ascending order of how intensively AI focused on

Accuracy after introduction

This inspection system has maintained high validation accuracy of 99.5% in pass/fail, 97.9% in classification by abnormality types

● Accuracy rate of inspection system

Validation type	Accuracy by the system	Accuracy by engineers
Pass/Fail, Classification	99.5%	95.0%
Classification by abnormality type	97.9%	

Publication outside the company

We have presented our efforts in working on the development at GTC, CEATEC Japan, IoT-SNAP and other events. Besides, our achievements have been featured in NHK's AI special program and Nikkei BP's book as an advanced attempt of introducing AI in actual production lines.

● NHK filming program

ディープ
ラーニング
活用の教科書

● Book carrying Fujikura's efforts and published by Nikkei BP

Future development

We have devised the road map and are advancing the introduction of technology and putting it to practical use.

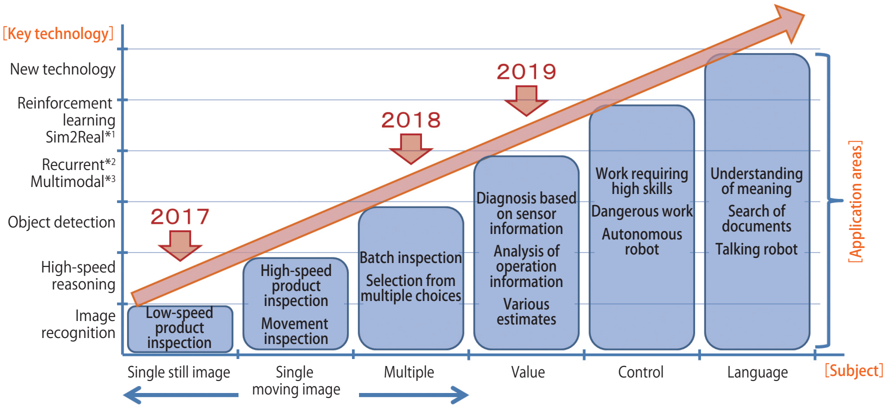
We aim to improve productivity by further introducing AI (deep learning) in our manufacturing business.

*1 Sim2Real: technology to use the learning results using simulation for autonomous control of actual robots

*2 Recurrent: technology to estimate and analyze relationship between data based on continuous data

*3 Multimodal: technology to reason multiple pieces of data individually, and then integrate them and reason

● Roadmap to introduction of AI (deep learning)


[Key technology]
New technology
Reinforcement learning Sim2Real*1
Recurrent*2 Multimodal*3
Object detection
High-speed reasoning
Image recognition
2017
2018
2019
Low-speed product inspection
High-speed product inspection
Movement inspection
Batch inspection
Selection from multiple choices
Diagnosis based on sensor information
Analysis of operation information
Various estimates
Work requiring high skills
Dangerous work
Autonomous robot
Understanding of meaning
Search of documents
Talking robot
[Application areas]
Single still image
Single moving image
Multiple
Value
Control
Language
[Subject]

Information

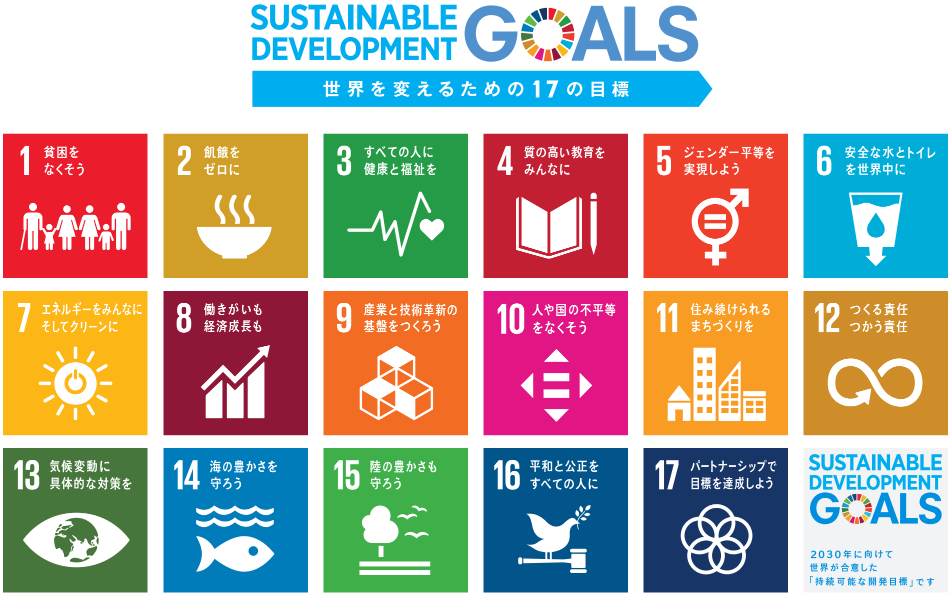
Fujikura's Efforts to Achieve Sustainable Development Goals

The Fujikura Group has been contributing to resolving social challenges by providing our products and services under our management philosophy of creating exceptional value for our customers around the world using "Tsunagu" (the Japanese word meaning "connecting") technologies. We also have been engaged in achieving SDGs (Sustainable Development Goals), which are international social challenges to be solved and were adopted by 193 UN member countries in September 2015.

The SDGs include 17 measure goals to be solved by 2030. The Fujikura Group declared that we would contribute to achieving the goals by solving these challenges through our business. These activities contributing to the achievement of SDGs through our business are shared by our CSV (creating shared value) activities to net increase valuation by society (social problem solving) and economic value (profit). We placed the year 2017 as "the Fujikura Group's first CSV year" and began full-scale activities. As an example of our activities, we organize and publish CSV products on Fujikura Group Integrated CSR Report. In addition, we hold workshops under the theme of "What can we do to achieve SDGs?" for new employees in employee training.

We will continuously work on solving social problems through our business operations and contribute to reaching SDGs.

● FY 2019 New Employee Training


SUSTAINABLE DEVELOPMENT GOALS
世界を変えるための17の目標
1 貧困をなくそう
2 飢餓をゼロに
3 すべての人に健康と福祉を
4 質の高い教育をみんなに
5 ジェンダー平等を実現しよう
6 安全な水とトイレを世界中に
7 エネルギーをみんなに そしてクリーンに
8 働きがいも経済成長も
9 産業と技術革新の基盤をつくろう
10 人や国の不平等をなくそう
11 住み続けられるまちづくりを
12 つくる責任 つかう責任
13 気候変動に具体的な対策を
14 海の豊かさを守ろう
15 陸の豊かさも守ろう
16 平和と公正をすべての人に
17 パートナーシップで目標を達成しよう
SUSTAINABLE DEVELOPMENT GOALS
2030年に向けて世界が合意した「持続可能な開発目標」です

Fujikura News introduces our different products, technologies and efforts every month.
From next month issue, each article will appear with suitable logos from those for "17 goals to transform our world."
Fujikura News Editing Committee

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